



United States
Office of Personnel Management

Mechanical Engineer

GS-0830

Human Resources Systems Service
Office of Classification
April 1996, HRCD-1

Note

This standard has been converted from the original paper format to electronic format without substantive change in series coverage or grading criteria. The standard was reviewed to correct errors that may have been introduced during the conversion process. In some standards minor corrections were made such as updating references to other documents that may have become obsolete, or correcting minor typographical errors in the original standard. Any errors that remain due to conversion to electronic format should be minor and are not intended to change the meaning of the original standard.

If you find page references near the right hand margin of this standard they indicate the pagination of the official, printed version of this standard. For example, a notation "PAGE 2, 4/88, TS-87" would mean that (1) page two of the printed version begins here, (2) the date of issuance was 4/88, and (3) the Transmittal Sheet number was TS-87.

Mechanical Engineering Series, GS-0830

CONTENTS

SERIES DEFINITION	1
EXCLUSIONS	1
OCCUPATIONAL INFORMATION	2
TITLES	2
GRADING OF POSITIONS	3
EVALUATION NOTES	4
GRADE CONVERSION TABLE	4
FACTOR-LEVEL DESCRIPTIONS	4
FACTOR 1, KNOWLEDGE REQUIRED BY THE POSITION	4
FACTOR 2, SUPERVISORY CONTROLS	7
FACTOR 3, GUIDELINES	9
FACTOR 4, COMPLEXITY	10
FACTOR 5, SCOPE AND EFFECT	13
FACTOR 6, PERSONAL CONTACTS	14
FACTOR 7, PURPOSE OF CONTACTS	15
FACTOR 8, PHYSICAL DEMANDS	15
FACTOR 9, WORK ENVIRONMENT	16
OPM BENCHMARK DESCRIPTIONS	16
MECHANICAL ENGINEER, GS-0830-05, BMK # 1	16
MECHANICAL ENGINEER, GS-0830-07, BMK #1	18
MECHANICAL ENGINEER, GS-0830-09, BMK #1	20
MECHANICAL ENGINEER, GS-0830-09, BMK #2	23
MECHANICAL ENGINEER, GS-0830-09, Bmk # 3	25
MECHANICAL ENGINEER, GS-0830-11, Bmk #:2	30
MECHANICAL ENGINEER, GS-0830-11, Bmk #:4	35
MECHANICAL ENGINEER, GS-0830-12, Bmk #:1	40
MECHANICAL ENGINEER, GS-0830-12, Bmk # 2	43
MECHANICAL ENGINEER, GS-0830-12, Bmk # 3	45
MECHANICAL ENGINEER, GS-0830-13, Bmk # 1	48
MECHANICAL ENGINEER, GS-0830-13, Bmk # 2	50
MECHANICAL ENGINEER, GS-0830-13, Bmk # 3	53
MECHANICAL ENGINEER, GS-0830-14, Bmk # 1	55
MECHANICAL ENGINEER, GS-0830-14, Bmk # 2	58

SERIES DEFINITION

This series includes professional positions in the field of mechanical engineering, typically requiring the application of thermo-dynamics, mechanics, and other physical, mathematical, and engineering sciences to problems concerned with the production, transmission, measurement, and use of energy, especially heat and mechanical power.

This standard is a revision of and supersedes the classification standard for the Mechanical Engineering Series, GS-830, published in August, 1968.

NOTE: The qualifications requirements for this occupation are included in the Qualification Standard for All Professional Engineering Series, GS-800.

EXCLUSIONS

Excluded from this series are the following classes of positions:

1. Positions which involve similar but nonprofessional engineering-type work. (See the Introduction to Engineering Group, GS-800; the Engineering Technician Series, GS-802; and other appropriate series.)
2. Positions which involve the application of mechanical engineering principles and practices, but which are primarily in subject-matter fields for which specialized series have been established. (See series definitions and classification standards for Nuclear Engineering Series, GS-840; and Aerospace Engineering Series, GS-861.)
3. Engineering positions engaged in work concerned primarily with design of a ship as a whole or with naval architectural principles relating to structures, stability, or hydromechanics. Thus excluded are positions concerned with mechanical cargo handling systems involving primarily ship structural and arrangement considerations. (See the Naval Architecture Series, GS-871.)
4. Professional engineering positions concerned with industrial production plants, facilities, and methods, where the work involves the design, improvement, or installation of integrated systems of men, materials, and equipment. Such positions are classifiable in the Industrial Engineering Series, GS-896.
5. Positions concerned with the application of knowledges and theoretical concepts characteristic of the field of physics, where the work requires primarily competence as a physicist. These positions are classifiable in the Physics Series, GS-1310.

6. Positions of chemical, petroleum, electrical, and other kinds of engineers who design mechanical equipment or perform other kinds of mechanical engineering work as an incidental part of a broader assignment such as the design of an oil refinery.

OCCUPATIONAL INFORMATION

Mechanical engineers make use of many materials and the physical laws governing them to produce systems and devices useful to mankind. The systems or items may be designed to function in a particular environment or under a wide range of conditions. They must use initiative, ingenuity, and imagination to produce needed inventions and developments.

Mechanical engineers in the Federal service engage in professional work in planning, research, development, design, test, valuation, production, installation, construction, maintenance, operation, and other functions. Typically, the work is concerned with facilities, systems, equipment, and instruments for production, transmission, measurement, control, and use of heat and mechanical power. Some of the typical specialty areas are:

- Industrial, construction, and materials handling equipment, and tools;
- Guns, fire control systems, ammunition, mines, missiles, and related weapons, equipment, and components;
- Heating, refrigeration, cryogenic, pumping, piping, and air-conditioning systems;
- Steam, internal combustion, and other powerplants and accessories, excluding aerospace propulsion systems;
- Automotive, industrial, construction, off-road and railroad vehicles, and mechanical components of aero-space, agriculture, and marine vehicles and structures;
- Mechanical controls, instruments, and measurement standards;
- Applied mechanics, including pneumatics, dynamics, ballistics, and strength of materials;
- Fuels and energy resources; and
- Hydraulic and/or electrical-mechanical power systems associated with civil works projects such as navigation locks and dams, multi-purpose flood control projects and hydroelectric power plants.

PAGE 2 6/77 TS-28

TITLES

"Mechanical Engineer" is the basic title authorized for positions classifiable to this series. Positions which involve supervisory duties and responsibilities as defined in the Supervisory Grade-Evaluation Guide are identified by the prefix "Supervisory."

GRADING OF POSITIONS

The grade level criteria in this standard may be used to classify nonsupervisory mechanical engineering positions at grades GS-5 through GS-15 in functional areas for which the separate functional grade evaluation guides are not applicable. Benchmarks provided in this standard cover nonsupervisory mechanical engineering positions at grades GS-5 through GS-14. Two types of work specifically included consist of:

- Professional design, construction and other work which is accomplished primarily by application of, modification of, adaptation of, or compromise with standard guides, precedents, methods, and techniques.
- Professional work which involves staff assignments as technical consultants and advisers and/or program coordinator-reviewers in engineering organizations engaged in or concerned with the preceding type of work.

Excluded from the coverage of the grade level criteria in this standard are the following categories of positions in the Mechanical Engineering Series, GS-830:

Positions of mechanical engineers who determine the value of property or facilities and costs related to providing services should be evaluated by reference to the GS-800, Valuation Engineering Grade-Evaluation Guide.

Positions limited primarily to planning, performing, evaluating and reporting of tests of equipment should be evaluated by reference to the GS-800, Test and Evaluation Engineering Grade-Level Guide.

Production engineering positions should be evaluated by reference to the GS-800, Grade-Evaluation Guide for Positions Concerned with Production.

Research positions should be evaluated by reference to the Research Grade-Evaluation Guide.

PAGE 4 6/77 TS-28

Development engineering positions should be evaluated by reference to the Equipment Development Grade-Evaluation Guide.

Positions that involve reviewing, evaluating, and recommending approval of research grants and contracts should be evaluated by reference to the Research Grants Grade-Evaluation Guide.

Positions of mechanical engineers engaged in education or training programs are classified by reference to the Grade-Evaluation Guide for Instructor and Specialist Positions Involving Education and Training Work.

Supervisory positions should be evaluated by reference to the Supervisory Grade-Evaluation Guide, Part II.

Evaluation Notes

Positions should be evaluated on a factor-by-factor basis, using one or more of the comparable Civil Service Commission benchmarks or Factor Level Descriptions for the Mechanical Engineering Series, or both. Only the designated point values may be used. More complete instructions for evaluating positions are contained in the introductory material for the Factor Evaluation System. The absence of a benchmark for positions at any grade from GS-5 to GS-15 does not preclude evaluation of positions at that grade.

GRADE CONVERSION TABLE

Total points on all evaluation factors are converted to GS grade as follows:

GS Grade	Point Range
5	855-1100
6	1105-1350
7	1355-1600
8	1605-1850
9	1855-2100
10	2105-2350
11	2355-2750
12	2755-3150
13	3155-3600
14	3605-4050
15	4055- up

PAGE 5 6/77 TS-28

FACTOR-LEVEL DESCRIPTIONS

FACTOR 1, KNOWLEDGE REQUIRED BY THE POSITION

This factor measures the nature and extent of information or facts which the engineer must understand to do acceptable work (e.g., steps, procedures, practices, rules policies, theories, principles, and concepts) and the nature and extent of skills necessary to apply these knowledges. To be used as a basis for selecting a level under this factor, a knowledge must be required and applied.

Level 1-5 -- 750 Points - A basic foundation of the concepts and principles of mechanical engineering including thermodynamics, mechanics and other physical, mathematical, and engineering sciences concerned with the production, transmission, measurement, and use of energy, especially heat and mechanical power. These knowledges would typically be acquired through a bachelor's degree program in mechanical engineering.

Level 1-6 -- 950 Points - Professional knowledge of conventional methods and techniques of a particular specialty area such as utilities, power plants, or marine equipment which would enable the engineer to independently perform assignments that are limited in scope and depth by such characteristics as:

- The problem is straightforward, or has been singled out of a larger investigation or project;
- Unknown factors or relationships are primarily matters of a factual nature or the mechanisms involved are fairly well-understood;
- The data can be obtained by use of established analytical and investigative methods and techniques with minor modifications and adaptations that can be worked out by conventional procedures; or
- The objectives to be reached are clearly identified and are realizable by minor adaptation of precedents and established practice.

Also, a general familiarity with the practices of related engineering disciplines, such as electrical and civil, as they apply to the specialty area.

Illustrations:

- Knowledges and skills necessary to design limited phases or segments of utility systems or to perform complete designs of utility systems for projects of limited size and complexity which can be accomplished by the application of well-established engineering methods.

PAGE 6 6/77 TS-28'

- Knowledges and skills necessary to perform the mechanical engineering work associated with the maintenance, repair and alteration of segments of mechanical systems in buildings and facilities at a military base.

Level 1-7 -- 1250 Points - Professional knowledges and abilities applicable to a wide range of duties in a specialty area; ability to modify standard practices and adapt equipment or techniques to solve a variety of engineering problems; ability to adapt precedent or make significant departures from previous approaches to similar projects in order to provide for the specialized requirements of some projects; ability to apply the standard practices of related engineering disciplines as they relate to the specialty area.

Illustrations:

- Knowledges and skills necessary to prepare designs and specifications for utility systems for multi-story office buildings, hospitals, etc.
- Knowledges and skills necessary to develop design features and plans for both repair and improvement projects and complete design of new mechanical systems for a variety of specialized floating plant, such as hopper dredges, floating power plants, tugboats, derrickboats, oil and water barges, etc.

Level 1-8 -- 1550 Points - Mastery of a specialty field to the extent that the engineer is capable of applying new developments and experienced judgment to solve novel or obscure problems; ability to extend and modify existing techniques; and ability to develop new approaches for use of other engineering specialists in solving a variety of engineering problems. Typically, the employee is a recognized expert in the specialty field.

OR

Equivalent knowledge and skill.

Illustrations:

- Knowledges and skills necessary to serve as a regional technical authority on all aspects of utilities production and distribution, with responsibility for providing expert advice on the interpretation and implementation of technical utilities policy directives and programs, as well as review of plans and specifications for projects in the region and provision of consultative services concerning the full range of mechanical utility systems.
- Knowledges and skills necessary to develop, revise and maintain agency mechanical engineering guide specifications and criteria, as well as portions of agency technical handbooks for guidance of agency engineering specialists, nationwide, and to furnish advice in the use and interpretation of the assigned technical guides.
- Knowledges and skills necessary to review and evaluate the work of mechanical engineers in field offices and activities by reviewing preliminary engineering reports and related design drawings and specifications on proposed, major construction projects; approving, disapproving, or modifying such features by preparing supplementary justification or projects.
- Knowledges and skills necessary to provide staff advisory, consulting and reviewing services within a centralized engineering office of an agency with responsibility for reviewing and coordinating all work in a specialty area and proposing additional work in light of the needs of the agency.

PAGE 7 6/77 TS-28

Level 1-9 -- 1850 Points - Mastery of a broad specialty field and recognized skill in generating new hypotheses, developing new concepts, and planning and evaluating long range programs and projects; or ability to function as a nationally recognized consultant and expert in a broad specialty field.

OR

Equivalent knowledge and skill.

Illustration:

-- Knowledges and skills necessary to serve as a recognized expert consultant to an agency having responsibility for the construction of mechanical facilities of unusual size and complexity with responsibility for evaluating, advising on and reporting on mechanical engineering activities nation- or world-wide.

FACTOR 2, SUPERVISORY CONTROLS

-- This factor covers the nature and extent of direct or indirect controls exercised by the supervisor, the engineer's responsibility, and the review of completed work.

-- Controls are exercised by the supervisor in the way assignments are made, instructions are given to the engineer, priorities and deadlines are set, and objectives and boundaries are defined.

-- The engineer's responsibility depends on the extent to which the engineer is expected to develop the sequence and timing of various aspects of the work, to modify or recommend modification of instructions, and to participate in establishing priorities and defining objectives.

PAGE 8 6/77 TS-28

-- The review of completed work depends upon the nature and extent of the review, e.g., close and detailed review of each phase of the assignment; detailed review of the finished assignment; spot check of finished work for accuracy; or review only for adherence to policy.

Note: Technical guidance may be furnished by a project leader or other higher graded engineer in the organization as well as the actual supervisor.

Level 2-1 -- 25 Points - For both one-of-a-kind and repetitious tasks the supervisor makes specific assignments that are accompanied by clear, detailed, and specific instructions.

The employee works as instructed and consults with the supervisor as needed and on all matters not specifically covered in the original instructions or guidelines.

The work is closely reviewed. This review may include checking progress as well as reviewing completed work for accuracy, adequacy, and adherence to instructions and established procedures.

Level 2-2 -- 125 Points - The supervisor provides continuing or individual assignments by indicating generally what is to be done, limitations, quality and quantity expected, deadlines, and priority of assignments. The supervisor provides additional, specific instructions for new, difficult, or unusual assignments including suggested work methods or advice on source material available.

The employee uses initiative in carrying out recurring assignments independently without specific instructions, but refers deviations, problems, and unfamiliar situations not covered by instructions to the supervisor for decision or help.

The supervisor assures that finished work and methods used are technically accurate and in compliance with instructions or established procedures. Review of the work increases with more difficult assignments if the employee had not previously performed similar assignments.

Level 2-3 -- 275 Points - The supervisor makes assignments by defining objectives, priorities, and deadlines; and assists employee with unusual situations which do not have clear precedents.

The employee plans and carries out the successive steps and handles problems and deviations in the work assignments in accordance with instructions, policies, previous training, or accepted engineering practices.

PAGE 9 6/77 TS-28

Completed work is usually evaluated for technical soundness, appropriateness, and conformity to policy and requirements. The methods used in arriving at the end results are not usually reviewed in detail.

Level 2-4 -- 450 Points - The supervisor sets the overall objectives and resources available. The employee and supervisor, in consultation, develop the deadlines, projects and work to be done.

The employee, having developed expertise in the specialty area is responsible for planning and carrying out the assignment; resolving most of the conflicts which arise; coordinating the work with others as necessary; and interpreting policy on own initiative in terms of established objectives. In some assignments, the employee also determines the approach to be taken and the methodology to be used. The employee keeps the supervisor informed of progress, potentially controversial matters, or far-reaching implications.

Completed work is reviewed only from an overall standpoint in terms of feasibility, compatibility with other work, or effectiveness in meeting requirements or expected results.

Level 2-5 -- 650 Points - The supervisor provides administrative direction with assignments in terms of broadly defined missions or functions.

The employee has responsibility for planning, designing and carrying out programs, projects, studies, or other work independently.

Results of the work are considered as technically authoritative and are normally accepted without significant change. If the work should be reviewed, the review concerns such matters as fulfillment of program objectives, effect of advice and influence of the overall program, or the contribution to the advancement of technology. Recommendations for new projects and alteration of objectives are usually evaluated for such considerations as availability of funds and other resources, broad program goals or national priorities.

FACTOR 3, GUIDELINES

This factor covers the nature of and the judgment needed to apply guidelines. Since individual assignments vary in the specificity, applicability, and availability of guidelines the constraints and judgmental demands placed upon engineers also vary. The existence of specific instructions, procedures, and policies may limit the opportunity of the engineer to make or recommend decisions or actions; however, in the absence of procedures or under broadly stated objectives, the engineer may use considerable judgment in researching literature and developing new methods. For this factor, guidelines refer to standard guides, precedent, methods, and techniques including:

PAGE 10 6/77 TS-28

- Agency manuals of instructions and operations;
- Standard textbooks;
- Manufacturer's catalogs and handbooks;
- Standard designs developed and prescribed by the central engineering staff of the agency;
- Master or guide specifications developed and prescribed by the central engineering staff of the agency;
- Files of previous projects undertaken by the agency;
- Standard work practices in the area of application as taught in engineering courses or generally accepted by engineers as a result of experience;
- Codes and standards published by recognized engineering societies and organizations including regulatory and enforcement agencies; and
- Governing policies and procedures of the agency.

Level 3-1 -- 25 Points - The engineer, generally a trainee, is provided specific guidelines such as technical manuals, instructions, and criteria that are detailed and directly applicable. The supervisor must authorize any deviations.

Level 3-2 -- 125 Points - The engineer is provided detailed and directly applicable guidelines such as standard instructions, literature, precedents, and practices in the area of assignment or

specialization. Judgment is required in locating and selecting the most appropriate guidelines and references. Established procedures for performing the work are used, but the engineer may exercise discretion in selection among alternative approaches. The employee may, on an irregular and infrequent basis, make minor deviations to adapt the guidelines to specific cases. Situations requiring significant deviations from existing guidelines are referred to the supervisor.

Level 3-3 -- 275 Points - Guidelines include standard instructions, technical literature, agency policies and regulations, manufacturer's catalogs and handbooks, precedents and standard practices in the area of assignment or specialization. The engineer independently selects, interprets, and applies the guides, modifying, adapting, and making compromises to meet the requirements of the assignment. In addition, the engineer must exercise judgment in applying standard engineering practices to new situations and in relating new work situations to precedent ones.

PAGE 11 6/77 TS-28

Level 3-4 -- 450 Points - Guidelines are often inadequate in dealing with the more complex or unusual problems. The engineer is required to use resourcefulness, initiative, and judgment based on experience to deviate from or extend traditional engineering methods and practices in developing solutions to problems where precedents are not applicable. This level may include responsibility for development of material to supplement and explain agency headquarters guidelines.

Level 3-5 -- 650 Points - Working chiefly under broad and general policy statements, regulations, and laws, the engineer exercises considerable judgment and ingenuity in interpreting and adapting guides that exist and in developing new and improved hypotheses, approaches, or concepts not previously tested or reported in the literature of the field. Frequently, the engineer is recognized as a technical authority in the specialty area, with responsibility for the development of policies as well as nationwide standards, procedures, and instructions to guide operating personnel.

FACTOR 4, COMPLEXITY

"Complexity" covers the nature and variety of tasks, steps, processes, methods, or activities in the work performed; and the degree to which the engineer must vary the work, discern interrelationships and deviations, or develop new techniques, criteria or information. The basic unit for measuring this factor is the "complex feature." A complex feature is an individual engineering problem, broadly defined, which requires (1) modification or adaptation of, or compromise with, standard guides, precedents, methods, or techniques; or (2) special considerations of planning, scheduling, and coordination. In crediting a complex feature to a position, the following conditions must be met:

- The duties and responsibilities of the position involve a specific, difficult problem, requiring substantial analysis and evaluation of alternatives.

-- The engineer in the position solves the problem, although it may be subject to preliminary discussion of background and possible approaches, and the solution may be reviewed for technical adequacy -- as well as for conformance with policy -- by the supervisor or others.

PAGE 12 6/77 TS-28

-- The solution of the problem involves (a) substantial modification or adaptation of, or compromise with, standard guides, precedents, methods, and techniques, or (b) difficult or unusual planning, scheduling, negotiating, or coordination.

-- The engineer applies a thorough knowledge of a variety of standard guides, precedents, methods, techniques, and practices in solving the problem.

Variations in the relative difficulty of work involving complex features are reflected below by the number of complex features and by their occurrence in combination. The interaction of complex features in combination is particularly significant in considering the relative intensity of all of the complex features in an assignment.

A complex feature can be concerned with technical engineering work or socio-economic, administrative, or other aspects of engineering work as illustrated in the following examples of complex features:

-- It is necessary to analyze and choose from among two or more standard methods from the standpoint of economy and engineering feasibility, when each approach contains advantages and disadvantages which do not readily or clearly outweigh those of the others. For example, cost considerations may dictate a compromise between a theoretically ideal method and a more economical, but technically less satisfactory, one. In like manner, there may be social, ecological, or other environmental considerations that make it necessary to analyze and weigh alternatives.

-- Standard material normally used by the agency in a given type of design is unavailable or is not suitable because of unfavorable local conditions. It is necessary to engage in an extensive literature search to arrive at a satisfactory substitute.

-- In making modifications or alterations to existing facilities it is necessary (a) to modify the design for loads and stresses not anticipated when the facility was originally designed, (b) to keep changes and costs to a minimum while achieving objectives, and (c) to modify standards and specifications to meet limitations of existing facilities.

-- Previous tests are not directly applicable in all phases because conditions to be simulated are different from those for which previous tests were conducted. It is necessary to devise departures from previous test methods and techniques to achieve the objectives of the test.

PAGE 13 6/77 TS-28

-- Special planning and scheduling is necessary to integrate completion dates for phases of Government work with phases to be performed by contractors, and, as necessary, to provide for continuing use of existing facilities.

- When proposed work infringes on State or municipal structures or requires approval of such authorities, the engineer coordinates with State or local civil authorities by personal contact and correspondence.
- The engineer presents special written analysis and justification to higher organizational entities regarding the economic, social, ecological, and other benefits that the general public will derive from the proposed work in comparison with estimated cost of such work.

Level 4-2 -- 75 Points - Assignments usually consist of specific, often unrelated, tasks that are designed to orient a trainee engineer in the practical application of theory and basic principles to ascertain the trainee engineer's interest and attitude; and to relieve experience engineers of detailed and simple work. Problems are readily solved by application of basic principles, elementary theories, and established practices. Work often consists of such detailed tasks as making calculations using standard formulas; preparation of graphs, curves, and tables; recording factual data in tests or from observation studies; drafting or minor detail design; and searching technical reports for information. At this level, tasks may be similar to those of nonprofessional employees, but are assigned primarily for training or development purposes.

Level 4-3 -- 150 Points - Assignments may consist of minor phases of a broader assignment of a higher-grade engineer which have typically been screened to eliminate complex features or may be similar to those previously encountered by the organization in which complex features occur infrequently or in isolated, single units. Assignments are carried out without substantial adaptation or modification of precedents, except for minor deviations -- such as sizes, dimensions, and relationships of details which can be resolved by engineering calculations typical of the specialization or area of assignment.

Level 4-4 -- 225 Points - Assignments typically contain combinations (e.g., two to five) of complex features. Work at this level typically involves the application of standard engineering practices to new situations and relating new work situations to precedent ones and, in addition, the modification or adaptation of and making compromises with standard guidelines.

PAGE 14 6/77 TS-28

Level 4-5 -- 325 Points - Assignments are of such breadth, diversity and intensity that they involve many, varied complex features. The work requires that engineers be especially versatile and innovative in adapting, modifying, or making compromises with standard guides and methods or originate new techniques or criteria. Assignments typically contain a combination of complex features which involve serious or difficult-to-resolve conflicts between engineering and management requirements.

Level 4-6 -- 450 Points - Assignments concentrate on the limitations or proven concepts and practices of a broad and complex subject-matter field or functional area where issues and factors to be considered are largely undefined requiring extensive probing and analysis to determine the nature and scope of the problems. In addition, the assignments are characterized by unusual demands that are frequently due to extraordinary emergency, public

interest, or economic restraints which create a need for the engineer to take short-cuts or make compromises that are considered risky or extreme within the context of standard guides, precedents, methods, and techniques. Analysis, as envisioned at this level, is carried to the point where either a solution is delivered on various problems or alternative further projects (pursued concurrently or sequentially with the support of others within or outside the organization) are initiated to alter standard concepts or theories, the objectives, and/or previously formulated requirements and criteria.

FACTOR 5, SCOPE AND EFFECT

This factor covers the relationship between the nature of the work, i.e., the purpose, breadth, and depth of the assignment, and the effect of work products or services both within and outside the organization. In General Schedule occupations, effect measures such things as whether the work output facilitates the work of others, provides timely services of a personal nature, or impacts on the adequacy of research conclusions. The concept of effect alone does not provide sufficient information to properly understand and evaluate the impact of the position. The scope of the work completes the picture, allowing consistent evaluations. Only the effect of properly performed work is to be considered.

Level 5-1 -- 25 Points - The purpose of the work is to orient the trainee engineer in the practical application of academic theory and basic principles. Work tasks are specific and limited and are primarily for training purposes to equip engineers to assume more responsible mechanical engineering duties. The work's effect is to facilitate the work of the other engineers within the immediate organizational unit.

PAGE 15 6/77 TS-28

Level 5-2 -- 75 Points - The purpose of the work is primarily to provide assistance to experienced engineers by relieving them of detailed and routine work. Work efforts have an effect on the accuracy and reliability, as well as the timeliness, of the projects being performed by higher level engineers.

Level 5-3 -- 150 Points - The purpose of the work is to investigate and analyze any of a variety of problems or conditions and to provide or recommend ways of dealing with them. The engineering determinations affect the design or operation of equipment or facilities, with regard to economy, efficiency and safety of the systems involved.

Level 5-4 -- 225 Points - The purpose of the work is to provide expertise as a specialist in a particular specialty field by furnishing advisory, planning or reviewing services on specific problems, projects, programs and functions. This work may include the development of criteria, procedures or instructions for major agency activities. Work products impact on a wide range of the agency's engineering program.

Level 5-5 -- 325 Points - The purpose of the work is to resolve critical problems or to develop new approaches or methods for use of other engineering specialists. Often serving as a consultant or project coordinator, the engineer provides expert advice and guidance to

officials, managers and other engineers within or outside the agency, covering a broad range of engineering activities. Results of the efforts affect the work of other engineering experts both within and outside the agency or the development of major aspects of agency engineering programs.

Level 5-6 -- 450 Points - The purpose of the work is to plan and conduct vital engineering programs for the agency, which are often of national or international scope and impact. The engineer's recommendations and decisions on highly complex technical and policy areas frequently establish the agency's position, create agency precedents and guide field installations on matters of major engineering significance. The employee's actions affect the agency's engineering program on a long-term and continuing basis and often influence the programs of other agencies and outside organizations.

FACTOR 6, PERSONAL CONTACTS

This factor includes face-to-face contacts and telephone and radio dialogue with persons not in the supervisory chain. (NOTE: Personal contacts with supervisors are covered under Factor 2, Supervisory Controls.) Levels described under this factor are based on what is required to make the initial contact, the difficulty of communicating with those contacted, and the setting in which the contact takes place (e.g., the degree to which the employee and those contacted recognize their relative roles and authorities).

PAGE 16 6/77 TS-28

Above the lowest level, points should be credited under this factor only for contacts which are essential for successful performance of the work and which have a demonstrable impact on the difficulty and responsibility of the work performed. The relationship of Factors 6 and 7 presumes that the same contacts will be evaluated for both factors. Therefore, use the personal contacts which serve as the basis for the level selected for Factor 7 as the basis for selecting a level for Factor 6.

Level 6-1 -- 10 Points - Personal contacts are primarily with higher grade engineers or experienced engineering technicians within the immediate office or related units within the agency.

Level 6-2 -- 25 Points - Personal contacts are with a number of employees in the agency, but outside the immediate office, such as engineers and engineering technicians in other disciplines, architects, field personnel, space managers, and shop employees.

Level 6-3 -- 60 Points - In addition to the intra-agency contacts described in Level 6-2 personal contacts include a variety of officials, managers, professionals or executives of other agencies and outside organizations. Typical of these contacts are manufacturers' representatives, private architect-engineer firms, specialists at contractors' plants and engineers and architects from other Federal agencies.

Level 6-4 -- 110 Points - Personal contacts are with high-ranking officials from outside the agency, including key officials and top engineering and scientific personnel of other agencies, State and local governments, private industry and public groups. The engineer may also participate, as a technical expert, in committees and seminars of national or even international importance.

FACTOR 7, PURPOSE OF CONTACTS

Purpose of personal contacts ranges from factual exchanges of information to situations involving significant or controversial issues and differing viewpoints, goals, or objectives. The personal contacts which serve as the basis for the level selected for this factor must be the same as the contacts which are the basis for the level selected for factor 6.

PAGE 17 6/77 TS-28

Level 7-1 -- 20 Points - Contacts are for the purpose of exchanging information about the work.

Level 7-2 -- 50 Points - In addition to the exchange of information, the purpose is to plan and coordinate work efforts with co-workers, discuss technical requirements of equipment with manufacturers and resolve any problems in its use, resolve questions of field personnel, discuss contract requirements, and generally clarify problems and reach agreement on overall plans and schedules. The persons contacted are usually working towards a common goal and generally are cooperative.

Level 7-3 -- 120 Points - The purpose is to influence or persuade other engineers to adopt technical points and methods about which there are conflicts, to negotiate agreements with agencies and contractors where there are conflicting interests and opinions among organizations or among individuals who are also experts in the field, or to justify the feasibility and desirability of work proposals to top agency officials.

Level 7-4 -- 220 Points - The purpose is to justify, defend, negotiate or settle highly significant or controversial engineering matters. Engineers often represent their agencies in professional conferences or committees to plan extensive and long-range engineering programs and to develop standards and guides for broad activities.

FACTOR 8, PHYSICAL DEMANDS

This factor covers the requirements and physical demands placed on the engineer by the work assignment. This includes physical characteristics and abilities (e.g., specific agility and dexterity requirements) and the physical exertion involved in the work (e.g., climbing, lifting, pushing, balancing, stooping, kneeling, crouching, crawling, or reaching.) To some extent, the frequency or intensity of physical exertion is also considered, e.g., a job requiring prolonged standing involves more physical exertion than a job requiring intermittent standing.

Note: Regulations governing pay for irregular or intermittent duty involving unusual physical hardship or hazard are in Chapter 550, Federal Personnel Manual.

Level 8-1 -- 5 Points - The work is principally sedentary, although there may be some walking or bending involved in activities such as inspections of installed equipment or construction-stage visits.

Level 8-2 -- 20 Points - The work requires regular and recurring construction inspections, in which there is a considerable amount of walking, stooping, bending and climbing.

PAGE 18 6/77 TS-28

FACTOR 9, WORK ENVIRONMENT

This factor considers the risks and discomforts that may be imposed upon employees by various physical surroundings or job situations. Although the use of safety precautions can practically eliminate a certain danger or discomfort, such situations typically require additional knowledges in terms of safety regulations and techniques.

Note: Regulations governing pay for irregular or intermittent duty involving unusual physical hardship or hazard are in Chapter 550, Federal Personnel Manual.

Level 9-1 -- 5 Points - Work is usually performed in an office setting, although there may be occasional exposure to conditions in buildings under construction or contractors' plants.

Level 9-2 -- 20 Points - There is regular and recurring exposure to moderate discomforts and unpleasantness, such as high levels of noise in contractors' plants, high temperatures around steam lines or adverse weather conditions at construction sites.

Level 9-3 -- 50 Points - Work involves regular and recurring to potentially dangerous or hazardous situations, e.g., working with explosives or incendiary materials; working in underground coal mines.

PAGE 19 6/77 TS-28

OPM BENCHMARK DESCRIPTIONS

MECHANICAL ENGINEER, GS-0830-05, BMK # 1

Duties

As a trainee mechanical engineer, performs duties which are designed to orient the employee in the application of academic theories and basic principles to mechanical engineering design work. Assignments are similar to those assigned to nonprofessional employees, but such

tasks are primarily for training purposes, and, in some cases, to relieve higher grade engineers to routine work.

- Receives formal and on-the-job instruction and training, designed to familiarize incumbent with functions and operations of the organization, and to provide experience in the practical application of basic mechanical engineering principles, techniques and concepts.
- Assists higher grade engineers, or works as a team member, in the design of mechanical systems for agency facilities.

Applies basic mechanical engineering knowledges to selected uncomplicated portions of such projects, performing tasks such as:

1. Drafting or minor detail design.
2. Applying basic formulas to routine calculations.
3. Preparing graphs, curves or tables for use of other engineers.
4. Searching technical reports or manufacturer's catalogs to obtain information for higher grade engineers.

Factor 1. Knowledge Required by the Position-Level 1-5 -- 750 Points

- Professional knowledge of mechanical engineering concepts and principles as would typically be acquired through a bachelor's degree program in mechanical engineering and would enable the engineer to perform trainee-level duties.

Factor 2. Supervisory Controls-Level 2-1 -- 25 Points

Supervisor assigns work with specific and detailed instructions as to what is required and guidance as to reports to be used and probable results. Work is carried out under the close supervision of a higher grade engineer. In addition, the supervisor is frequently consulted on matters not specifically covered in the original instructions or guidelines. Work is reviewed in progress and on completion for technical accuracy and conformance to instructions.

PAGE 20 6/77 TS-28

Factor 3. Guidelines-Level 3-1 -- 25 Points

Guidelines include technical manuals, directives and criteria which are detailed and directly applicable. The employee works in strict adherence to the guidelines, consulting the supervisor for authorization of any deviations.

Factor 4. Complexity-Level 4-2 -- 75 Points

Assignments consist of specific, often unrelated tasks, designed to orient the trainee in the practical application of theory and basic principles. These tasks are usually the routine and detailed work involved in projects being performed by higher grade engineers.

Factor 5. Scope and Effect-Level 5-1 -- 25 Points

The purpose of the work is to orient the trainee engineer in the practical application of academic theory and basic principles. The effect of the work is to facilitate the work of other engineers within the immediate office.

Factor 6. Personal Contacts-Level 6-1 -- 10 Points

Contacts are with higher grade engineers and engineering technicians within the immediate office.

Factor 7. Purpose of Contacts-Level 7-1 -- 20 Points

Contacts are for the purpose of obtaining advice and direction and reporting on findings.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Sedentary work.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work performed in an office setting.

TOTAL POINTS -- 940

PAGE 21 6/77 TS-28

MECHANICAL ENGINEER, GS-0830-07, BMK #1*Duties*

Performs specified portions or minor phases of assignments pertaining to the design of mechanical systems for buildings such as hospitals, office buildings, penal institutions, etc. Assignments are typically screened to eliminate difficult or unusual problems. Mechanical systems include heating, ventilating, air conditioning, plumbing, refrigeration, sprinklers and steam distribution.

- From specific instructions, notes or sketches provided by a higher grade engineer, prepares layout and detail drawings on relatively routine projects or works on a portion of a larger and more complex project which has been assigned to a higher grade engineer.
- Performs necessary calculations such as heat loss, required capacities, size of piping, boiler size, etc.

-- Studies engineering texts, periodicals, manufacturer's publications and other technical material to obtain information on materials, equipment and pertinent data to be used by higher level engineers in the development of specifications for mechanical installations.

-- Visits construction sites to obtain specified information on environmental factors, condition of existing structures, etc.

-- Reviews architectural-engineering work of minor complexity under supervision of a senior mechanical engineer.

-- Reviews contractor's shop drawings for adherence to contract specifications and brings any deviations to the attention of the supervisor.

Factor 1. Knowledge Required by the Position -- Level 1-6 -- 950 Points

-- Professional knowledge of mechanical engineering principles and concepts as well as the ability to apply standard engineering practices, methods and techniques to perform relatively limited design work such as preparation of layouts and detail drawings for elements of utility systems, e.g., pipes, control valves, pumping equipment or ventilating ducts.

-- Familiarity with related engineering disciplines, particularly structural and electrical.

PAGE 22 6/77 TS-28

Factor 2. Supervisory Controls -- Level 2-2 -- 125 Points

Supervisor provides assignments with specific instructions as to the objectives, scope and procedures to be used. Work of a repetitive nature is performed independently. The employee frequently consults with the supervisor or a higher grade engineer on any deviations, problems or unusual situations. Upon completion, work is reviewed for accuracy and adherence to standard practices, and to assure conformance with requirements.

Factor 3. Guidelines-Level 3-2 -- 125 Points

Guidelines include technical manuals, directives, agency criteria, engineering texts, previous engineering specifications and established methods. These guidelines are detailed and usually are directly applicable to the assigned work. The employee must exercise some judgment in selecting appropriate guidelines and deciding among alternative approaches. Situations where existing guidelines are inadequate are referred to the supervisor.

Factor 4. Complexity-Level 4-3 -- 150 Points

Assignments consist of varied projects which are designed to provide diversified experience as a foundation for future project responsibility. Assignments are typically screened to eliminate difficult or unusual problems. Work does require familiarity and use of a number of standard engineering principles, methods and practices in order to solve relatively limited professional problems.

Factor 5. Scope and Effect-Level 5-2 -- 75 Points

The purpose is to prepare layouts and detail drawings for relatively routine portions of larger projects. Work efforts have an impact on the adequacy of designs as well as relieving higher grade engineers of the more routine work.

Factor 6. Personal Contact-Level 6-2 -- 25 Points

Personal contacts are with other engineers and engineering technicians within the immediate office, agency building operators or agency construction engineering personnel.

Factor 7. Purpose of Contacts-Level 7-1 -- 20 Points

Contacts are chiefly to gain advice or assistance, to report on status or results of work, and to get information on condition of existing facilities.

PAGE 23 6/77 TS-28

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Work is sedentary except for occasional walking and bending during construction-site visits.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is usually performed in an office setting, although there are occasional visits to construction sites.

TOTAL POINTS -- 1480

PAGE 24 6/77 TS-28

MECHANICAL ENGINEER, GS-0830-09, BMK #1*Duties*

Performs design and layout of mechanical equipment systems such as plumbing, heating, air conditioning, sprinkler, steam distribution, etc., and prepares working drawings for installation of the systems in government buildings such as hospitals, office buildings, penal institutions and related structures. Projects include additions and renovations to existing structures and, to a lesser extent, new construction. Employee has complete design responsibility for small, routine projects and performs portions of large, complex projects under the direction of a higher grade engineer.

- Reviews architect's working drawings and any design commitments made to using agency.
- Makes calculations and sizes the equipment taking into consideration the facility's needs.

- Reviews previous specifications, architectural plans, building codes, etc., to gather supplementary data on which to base designs.
- Visits work site to gather first-hand such information as condition of facilities, location of sewer mains, local water pressure, plumbing layouts, etc.
- Coordinates with architects and structural and electrical engineers to avoid interferences and ensure proper integration of systems.
- Prepares preliminary and final designs of mechanical systems with regard to the needs of the user, space, capacities and economy.
- Reviews shop drawings submitted by contractors to determine that they conform with agency specifications of construction details and to assess suitability of materials.

Factor 1. Knowledge Required by the Position-Level 1-6 -- 950 Points

- Professional knowledge of mechanical engineering concepts and principles and a practical knowledge of conventional methodology to perform relatively routine mechanical design projects or portions of large complex projects for use in office buildings, hospitals, penal institutions and similar structures.
- Familiarity with related engineering fields, such as structural and electrical.
- Ability to design mechanical utility systems such as could be acquired through a bachelor's degree program in mechanical engineering supplemented by experience in the specialty field.

PAGE 25 6/77 TS-28

Factor 2. Supervisory Controls-Level 2-3 -- 275 Points

Supervisor assigns complete projects of moderate scope or parts of more complex projects with instructions as to the general types and applications of the systems to be used and any design commitments made to architects or other engineers. Employee makes independent decisions on technical matters which are treatable by standard practices and techniques.

Unusual problems are referred to the supervisor or project leader with a recommendation for their solution.

Work is reviewed upon completion for technical adequacy and consistency with objectives.

Factor 3. Guidelines-Level 3-3 -- 275 Points

Established precedents, procedures, approaches, and techniques exist. The employee studies, evaluates, and selects available reference information and regularly makes limited adaptations of established techniques and methods to meet the needs of the assignment.

Where significant deviations are required, the employee will refer the problem to the supervisor along with proposed solutions, which are normally accepted. The employee also

refers to manufacturers' catalogs and handbooks, and standard designs developed and prescribed by others for similar purposes.

Factor 4. Complexity-Level 4-3 -- 150 Points

Assignments involve primarily small or conventional systems, but also include assisting higher-grade engineers on large, complex projects. Work requires the independent application of a variety of established engineering practices. Some problems necessitate minor adaptation of standard techniques. Occasionally complex features requiring more significant deviations must be treated, but these typically occur in isolated, single units.

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose is to prepare designs and working drawings for mechanical systems for government buildings, involving the solution of design problems. The engineering determinations have an impact on the safety, economy, efficiency, types and sizes of systems to be installed.

PAGE 26 6/77 TS-28

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with in-house engineers and architects, officials and managers of the using agency, contractors, and manufacturers' representatives.

Factor 7. Purpose of Contacts-Level 7-2 -- 50 Points

Contacts are to exchange information, coordinate on projects, discuss contract requirements, and obtain information on equipment.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Work is chiefly sedentary with some minor physical activity during construction-site visits.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is usually performed in an office setting, although there is occasional exposure to conditions in buildings under construction.

TOTAL POINTS -- 1920

PAGE 27 6/77 TS-28

MECHANICAL ENGINEER, GS-0830-09, BMK #2*Duties*

Performs duties concerned with the administration of the mechanical aspects of contracts for government buildings and facilities, ensuring that actual construction complies with contract designs and specifications and safety requirements. Work involves mostly repair and improvement projects, but does include some new construction. Employee may be assigned complete project responsibility for relatively routine projects, or a portion of a large and complex project which has been assigned to a higher grade engineer.

- Once contract has been awarded, assumes responsibility for carrying it out.
- Attends pre-construction meeting, along with contractor and client agency, to discuss the contract and make arrangements to begin construction.
- Conducts frequent inspections to ensure that work being done is consistent with plans and specifications and doesn't violate any code requirements.
- Makes recommendations based on observation of tests and review of test data regarding such technical matters as possible changes in construction procedures, techniques and materials.
- Advises and coordinates with contractor on design deficiencies or unforeseen conditions which arise during the course of construction and which may necessitate modifications in the contract. Also consults with the designer to resolve these problems.
- Estimates cost of contract changes and processes change orders.
- Upon completion of construction, conducts a final inspection and writes up a defects and omissions list for contractor to complete before final payment is made.
- Discusses any construction deficiencies or problems with officials of the using agency and together with the contractor, determines necessary adjustments.

Factor 1. Knowledge Required by the Position-Level 1-6 -- 950 Points

- Professional knowledge of mechanical engineering principles and concepts and a knowledge of conventional methods and techniques needed to monitor relatively routine construction projects or assist in monitoring larger projects.
- Familiarity with related engineering disciplines, especially structural and electrical.
- Ability to monitor the mechanical aspects of construction contracts from a professional mechanical engineering perspective such as could be acquired through a bachelor's degree program in mechanical engineering, supplemented by experience in design or construction of utility systems.

Factor 2. Supervisory Controls-Level 2-3 -- 275 Points

Supervisor provides project objectives, priorities, time limitations, background and anticipated problems. The employee independently carries out most of the work, handling routine problems without assistance. The supervisor or a senior engineer is available for consultation and advice for deviation from standard principles and practices. Completed work is reviewed for technical adequacy and soundness of results. Work which deviates from accepted engineering methods is reviewed more closely while in progress and upon completion.

Factor 3. Guidelines-Level 3-3 -- 275 Points

Guidelines include agency policy and regulations, technical literature, standard practices and, most importantly, the contract plans and specifications for the assigned project. The employee must exercise independent judgment in interpreting the specifications and selecting and applying the technical guides. Problems regularly arise during construction which require the employee to make minor adaptations of the guidelines.

Factor 4. Complexity-Level 4-3 -- 150 Points

Assignments consist of project responsibility for relatively routine construction projects, or a portion of a large and complex project which has been assigned to a higher grade engineer. Work requires the independent application of different, but established methods, procedures and techniques. Most problems are treatable by no more than minor adaptation of established practices.

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose of the work is to assure proper construction of the assigned projects by ensuring that the contractor's work is in compliance with contract designs and specifications, and to resolve day-to-day problems that occur during construction. Work efforts have an impact on the economy, efficiency and safety of the involved facilities.

PAGE 29 6/77 TS-28

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with the contractor, officials and space managers of the using agency, architects and engineers who designed the work (either within the agency or a private architect-engineer firm), and equipment manufacturers and suppliers.

Factor 7. Purpose of Contacts-Level 7-2 -- 50 Points

Contacts are to exchange information, discuss needs and requirements of the using agency, resolve contractor's problems or discuss interpretations of specifications, and obtain information about equipment.

Factor 8. Physical Demands-Level 8-2 -- 20 Points

The work involves frequent construction-site inspections, requiring considerable walking, bending and climbing.

Factor 9. Work Environment-Level 9-2 -- 20 Points

Work time is normally equally divided between office and field. Construction-site visits frequently expose the employee to moderate discomforts, such as adverse weather conditions or high temperatures around steam lines.

TOTAL POINTS -- 1950

PAGE 30 6/77 TS-28

MECHANICAL ENGINEER, GS-830-9, Bmk #: 3*Duties*

Performs design and layout work for conventional marine propulsion systems, including main propulsion machinery, auxiliary machinery, and heat exchange equipment for various classes of naval vessels. Projects include additions and renovations to existing systems, equipment and machinery. The employee generally performs portions of large, complex projects under the direction of a higher grade engineer.

- Reviews working drawings and any design commitments made. Performs sound and/or vibration studies of machinery and affected structures.
- Makes calculations and sizes the equipment taking into consideration the needs of the ship.
- Reviews previous specifications, agency class plans, manufacturers' manuals, etc. to gather supplementary data on which to base designs.
- Performs ship-checks for the purpose of gathering first-hand such information as existing conditions, layout of existing piping, interference, steam and/or water pressure, etc.
- Coordinates with naval architects and electrical engineers to avoid interferences and ensure proper integration of systems.
- Witnesses and conducts tests of shipboard machinery to determine existing problems. Analyzes problems and makes recommendations for their resolution.
- Prepares preliminary and final designs of mechanical systems with regard to the needs of the user, space, capacities and economy.
- Reviews designs and working drawings submitted by contractors to determine that they conform with agency specifications of construction details and to assess suitability of materials.

Factor 1. Knowledge Required by the Position-Level 1-6 -- 950 Points

- Professional knowledge of mechanical engineering concepts and principles and a practical knowledge of conventional methodology to perform relatively routine mechanical design projects or portions of large complex projects for use in various classes of naval ships.
- In addition to standard professional mechanical engineering knowledges, this specialty requires knowledge of ship design and ship operating conditions and of the specialized factors associated with a marine environment.
- Familiarity with related engineering fields, such as naval architecture and electrical engineering.
- Ability to design marine propulsion systems such as could be acquired through a bachelor's degree program in mechanical engineering supplemented by experience in the specialty field.

PAGE 31 6/77 TS-28

Factor 2. Supervisory Controls-Level 2-3 -- 275 Points

Supervisor or project leader assigns parts of complex design projects with instructions as to the general types and applications of the systems to be used and any design commitments made to other engineers. The employee generally works under the technical direction of the project leader. Employee makes independent decisions on technical matters which are treatable by standard practices and techniques. Unusual problems are referred to the supervisor or project leader with a recommendation for their solution. Work is reviewed upon completion for technical adequacy and consistency with objectives.

Factor 3. Guidelines-Level 3-3 -- 275 Points

Established precedents, procedures, approaches, and techniques exist. The employee studies, evaluates, and selects available reference information and regularly makes limited adaptations of established techniques and methods to meet the needs of the assignment. Where significant deviations are required, the employee will refer the problem to the supervisor along with proposed solutions, which are normally accepted. The employee also refers to manufacturers' catalogs and handbooks, and standard designs developed and prescribed by others for similar purposes.

Factor 4. Complexity-Level 4-3 -- 150 Points

Assignments involve primarily conventional systems, but the employee also assists higher-grade engineers on large, complex systems. Work requires the independent application of a variety of established engineering practices. Problems encountered often necessitate minor adaptation of standard techniques. Problems requiring significant departures from established practices occur infrequently.

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose of the work is to prepare designs and working drawings for mechanical systems for various classes of naval vessels. The engineering determinations have an impact on the safety, economy, efficiency, types and sizes of systems to be installed.

PAGE 32 6/77 TS-28

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with in-house engineers, ship's force personnel, shipboard machinists, and manufacturers' representatives.

Factor 7. Purpose of Contacts-Level 7-2 -- 50 Points

Contacts are to exchange information, coordinate on projects, discuss contract requirements, and obtain information on equipment.

Factor 8. Physical Demands-Level 8-2 -- 20 Points

Frequent surveys of shipboard conditions require a considerable amount of walking, climbing and bending.

Factor 9. Work Environment-Level 9-2 -- 20 Points

Work requires regular shipboard visits which expose the employee to moderate discomforts, such as excessive heat and high noise levels.

TOTAL POINTS -- 1950

PAGE 33 6/77 TS-28

MECHANICAL ENGINEER, GS-830-11, Bmk #: 1*Duties*

Performs design and layout of plans for heating, ventilating, air conditioning and refrigeration systems for hospitals, research buildings and similar facilities. Projects include new construction and additions or renovations to existing structures.

- Reviews design architect's working drawings which indicate building size and general arrangement.
- Makes field surveys to investigate existing equipment layout and conditions.
- Analyzes mechanical needs, makes calculations and determines types of systems most suitable to meet requirements of building within the prescribed budget.

- Prepares original designs and preliminary and final layout of heating, ventilating and air conditioning systems with regard to size, space, capacities and economy.
- Sizes the equipment according to the facility's needs, ensuring conformance with agency specifications.
- Coordinates assignment with other agency engineers and architects responsible for the adequacy of related features such as plumbing, lighting, power and structures to ensure proper integration of the assignment.
- Reviews architect-engineer plans and specifications for adequacy and feasibility.
- Reviews and recommends approval of mechanical equipment, shop drawings and technical data submitted by contractors, ensuring conformance with plans and making recommendations as to the suitability of new processes and methods.
- Participates in final on-site inspection.

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250 Points

-- Professional knowledge of mechanical engineering concepts, principles and practices applicable to the full range of engineering duties concerned with the design and layout of heating, ventilating, air conditioning and refrigeration systems for use in hospitals, research buildings and similar structures.

PAGE 34 6/77 TS-28

- Familiarity with related engineering fields, such as electrical and structural.
- Ability to design mechanical utilities such as would be acquired through a bachelor's degree program in mechanical engineering, supplemented by several years experience in design of mechanical utility systems.

Factor 2. Supervisory Controls-Level 2-3 -- 275 Points

Supervisor assigns work in terms of project objectives and priorities. The employee determines the nature of the questions and issues involved and independently plans and carries out the work assignment according to accepted engineering practices. Unusual or complex problems are referred to the supervisor, accompanied by recommendations or alternate solutions. Completed work is reviewed for adequacy, soundness of technical judgment and compatibility with work of other engineers. Detailed calculations, findings and recommendations on routine assignments are accepted as technically accurate, but may be checked or verified.

Factor 3. Guidelines-Level 3-4 -- 450 Points

Guidelines include the agency construction standards, manufacturer's bulletins, technical journals, various engineering guides and manuals and established procedures. These guidelines are often inadequate in dealing with the more complex assignments and they seldom provide concrete solutions to specific design problems. The work requires the employee to deviate from standard mechanical engineering practices and methods in solving problems for which precedents are not directly applicable due to such factors as unusual local

conditions or the specialized requirements of a particular facility. The employee must adapt techniques or methods and use experienced judgment in selecting approaches and evaluating findings.

Factor 4. Complexity-Level 4-4 -- 225 Points

The assignments are diverse covering a number of essentially different mechanical systems and equipment found in the buildings. The employee must adapt and modify conventional practices and apply design criteria to the projects assigned. The work also requires recognition of the relationship of problems and practices of related engineering fields either to solve the engineering problem or refer it to the appropriate source. Hospital design projects pose especially complex problems in dealing with the specialized requirements for air control and humidity control. For example, operating rooms require strict control of humidity, as low humidity levels cannot be tolerated. In addition, the varying requirements of each hospital necessitate substantial modifications from precedents and standard guides.

PAGE 35 6/77 TS-28

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose is to perform the mechanical engineering design work for new construction and additions or renovations to existing structures. Work has an impact on the safety, economy, efficiency, type and sizes of systems to be installed.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with manufacturer representatives, agency field project personnel and other agency engineers and architects at the central office.

Factor 7. Purpose of Contacts-Level 7-2 -- 50 Points

Contacts with manufacturer representatives are for the purpose of obtaining advice or resolving problems concerning equipment. Contacts with agency engineering and architectural personnel are to give and receive information, to coordinate work efforts and resolve technical problems and to review drawings and specifications.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Occasional physical activity is required including walking, bending, or stooping during field surveys or the inspection of the installed equipment.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is performed primarily in an office setting, although there are occasional visits to project sites.

TOTAL POINTS -- 2470

MECHANICAL ENGINEER, GS-830-11, Bmk #: 2*Duties*

Performs field and office mechanical engineering duties associated with the construction of large industrial and office buildings, ensuring that the building's mechanical systems are constructed in accordance with contract plans and specifications. Mechanical systems include heating, ventilating, air conditioning, water, sewerage, and sprinkler systems with related electrical control circuitry.

- Reviews architect-engineer's plans and specifications to assure construction feasibility and recommends necessary changes.
- Prepares the mechanical portions of government estimates, reviews contractor's proposals and assists in negotiations with contractor.
- Investigates a variety of problems which the contractor experiences in construction, such as interference between mechanization and other specializations or other modifications in the original design which the contractor feels are necessary or desirable. Coordinates with the designer and contractor in making design changes.
- Assures quality control and adequacy of contractor's operations and confers with contractor to obtain corrective action.
- Reviews mechanical portions of contractor's progress charts and conducts field surveys to verify fulfillment of contractor's construction estimates for the purpose of determining monthly progress payments to the contractor.
- Reviews shop drawings, schedules, mechanical layouts, etc. to ensure that changes are in compliance with contract specifications.
- Assures that contractor maintains the required records and drawings and is recording deviations from plans.
- Assures compliance with government safety program.

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250 Points

- Professional knowledge of mechanical engineering concepts, principles, and practices applicable to the full range of engineering duties concerned with the construction of mechanical systems (heating, ventilating, air conditioning, plumbing, sprinklers) for use in government buildings.
- These knowledges include stress analysis, machine design, heat load calculations, duct and pipe sizing and layout, equipment sizing and layout and the fundamentals of thermodynamics, fluids flow, heat transfer, materials and engineering design.
- Familiarity with other engineering disciplines, especially electrical.

-- Ability to monitor the mechanical engineering aspects of large-scale construction projects from a professional mechanical engineering perspective to ensure compliance with contract plans and specifications. Knowledge such as could be acquired through a bachelor's degree program in mechanical engineering, supplemented by several years of experience in construction or design of a variety of utility systems.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

The employee has responsibility for the proper installation of the utility systems in the buildings and receives little or no direction from the supervisor in handling day-to-day problems. Essentially, the employee is responsible for planning and carrying out the work, coordinating with others, and in most cases, determining approaches to be taken. The supervisor is kept informed of progress and any large-scale problem matters. Completed work is reviewed mainly for effectiveness in meeting requirements and dealing with problems.

Factor 3. Guidelines-Level 3-3 -- 275 Points

The most significant guidelines are the contract plans and specifications. Other guidelines include agency policies and regulations, local codes, engineering standards, technical handbooks, and established practices. The guidelines generally apply to most situations, although occasionally problems arise for which they are not completely applicable, such as interferences between specializations or other design deficiencies. The employee must use judgment in selecting and applying the guidelines and, in some cases, must adapt guidelines to resolve problem situations.

Factor 4. Complexity-Level 4-4 -- 225 Points

Work covers a number of essentially different mechanical systems and equipment found in buildings. The engineer is required to deal with several complex features, including the need to modify the original design to solve problems of interference between mechanization and other specializations and special scheduling requirements to integrate various phases of the work. The work requires considerable coordination with related engineering fields.

PAGE 38 6/77 TS-28

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose of the work is to ensure that the mechanical features of the buildings are installed according to plans and specifications and to deal with any problems which arise during the course of construction. Work has a significant impact on the operation of the facilities, with respect to effectiveness and safety of the systems being installed.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Employee has extensive contacts with the prime contractor and the mechanical contractor. In addition, he has contacts with the designers in the architect-engineer firms, other agency engineers and architects, and at times, with tradesmen involved in the actual construction.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts are to coordinate the work efforts with other agency engineers, to discuss contract requirements, to give advice on resolving problem situations, and generally to monitor the quality and progress of the project. Contacts with contractors often involve serious differences that require persuasion and diplomacy in order to reach agreement.

Factor 8. Physical Demands-Level 8-2 -- 20 Points

The work requires frequent and recurring construction inspections which require a good deal of walking, climbing, stooping and bending.

Factor 9. Work Environment-Level 9-2 -- 20 Points

Considerable time is spent on-site, where the employee is exposed to moderate discomforts, such as noise and adverse weather and some minor risks due to equipment being moved, welding being performed, etc.

TOTAL POINTS -- 2570

PAGE 39 6/77 TS-28

MECHANICAL ENGINEER, GS-830-11, Bmk #: 3*Duties*

Performs duties concerned with the preparation of plans, specifications, and engineering estimates covering repairs, maintenance and improvement of mechanical equipment aboard a variety of specialized floating plant, such as hopper dredges, drift collectors, survey boats, etc.

- Makes surveys of floating plant, determines repairs and replacements required or other alterations to improve efficiency. Surveys may cover any major item of equipment aboard the vessel, such as propulsion engines, pumps, turbines, or component systems which may include unloading systems, heating and ventilation. Determines corrective action or equipment required.
- Contacts suppliers and manufacturers or consults equipment catalogs or technical publications for substitutes or replacements.
- Prepares preliminary engineering designs, specifications and estimates.

- After review and approval of project by higher authority, prepares final plans, specifications and cost estimates covering work to be performed.
- For contract work, investigates the capability of the apparent low bidders considering past performance, methods of operation, manpower, etc.
- Serves as the contracting officer's liaison during shipyard overhauls. Reviews contract requirements and items of work with the contractor.
- Observes work in progress to ensure conformance to contract plans and specifications and code requirements.
- Recommends modifications in work being performed and prepares necessary specifications, change order documents, cost estimates and related correspondence.

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250 Points

- Professional knowledge of mechanical engineering principles and practices applicable to the full range of engineering duties concerned with the design of mechanical systems aboard floating plant.
- Ability to monitor contractor's work to ensure conformance to contract plans and specifications and code requirements.

PAGE 40 6/77 TS-28

- In addition to standard professional mechanical engineering knowledges, this specialty requires knowledge of ship design and ship operating conditions and of the specialized factors associated with a marine environment.
- Familiarity with other engineering disciplines, such as electrical and structural.
- Ability to design mechanical systems for floating plant, such as could be acquired through a bachelor's degree program in mechanical engineering, supplemented by several years experience in design or maintenance of mechanical systems and some experience with a marine environment.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

Supervisor gives assignments in general terms of objectives and priorities. The employee has responsibility for the proper repair, maintenance and improvement of the assigned vessels and receives only administrative direction from the supervisor during the course of most assignments. Highly unusual or controversial problems are handled in consultation with the supervisor, but, in most cases, the employee independently plans and carries out the work. Completed work is reviewed for adequacy in meeting objectives and to ensure conformance with agency policies.

Factor 3. Guidelines-Level 3-3 -- 275 Points

Guidelines include agency guide specifications, technical journals, manufacturer's catalogs, various engineering manuals and established procedures. While these guides generally apply to most situations, the employee must independently select and apply engineering methods

and techniques, making adaptations when necessary in dealing with the specialized requirements of different vessels.

Factor 4. Complexity-Level 4-4 -- 225 Points

Assignments cover a number of essentially different mechanical systems found aboard assigned vessels. The specialized requirements of individual vessels require the employee to explore alternatives and choose between several approaches used previously. Projects are generally of a conventional nature, however, situations do arise which necessitate modification of standard methodology, e.g., where limitations on available space, weight, materials or cost require judgment in making compromises between the theoretical and the practical to arrive at a feasible design solution.

PAGE 41 6/77 TS-28

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose of the work is to prepare plans and specifications for repairs, maintenance and improvement of mechanical equipment aboard a variety of specialized floating plant. The engineering determinations have an impact on the efficiency, economy, and safety of the systems repaired, maintained or installed.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with other agency engineers, manufacturer's representatives, contractors and shop personnel.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts are for the purpose of exchanging information, coordinating projects, discussing equipment requirements with manufacturers, and monitoring and recommending changes in contractors' work. These contacts with contractors often involve technical disagreements which require persuasion and tact to resolve.

Factor 8. Physical Demands-Level 8-2 -- 20 Points

A considerable amount of physical activity is required including walking, climbing and bending during repeated shipyard inspections.

Factor 9. Work Environment-Level 9-2 -- 20 Points

Work requires frequent and recurring shipyard visits which expose the employee to moderate discomforts, including dirty conditions and adverse weather.

TOTAL POINTS -- 2570

MECHANICAL ENGINEER, GS-830-11, Bmk #: 4*Duties*

Performs engineering studies, makes calculations, and prepares plans and specifications for conventional marine propulsion systems for various classes of naval vessels. The work includes main propulsion machinery, auxiliary machinery, and heat exchange equipment.

- Performs a variety of studies and calculations, such as propeller shaft torsional vibration calculations, studies related to smokestacks for elimination of smoke nuisance, studies related to condenser scoop design to assure satisfactory hydrodynamic flow, and calculations for determining the safety of high pressure - high temperature piping systems.
- Prepares plans, specifications and technical instructions for installation of marine propulsion systems.
- Reviews plans, specifications, calculations, etc. prepared by contractors or engineering personnel within the branch for compliance with established design standards and operational efficiency.
- Makes surveys of vessels to determine applicability of available plans, check proposed locations of equipment or piping, and clear up any interferences or clearance problems.
- Maintains frequent contact with other branches and contractors to exchange technical data, explain and interpret design requirements, discuss debatable technical issues, and resolve interferences.

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250 Points

- Professional knowledge of mechanical engineering principles and practices applicable to the full range of engineering duties concerned with the design of marine propulsion systems.
- In addition to standard professional mechanical engineering knowledges, this specialty requires knowledge of ship design and ship operating conditions, and of the specialized factors associated with a marine environment.
- Familiarity with other engineering disciplines, such as electrical and structural.
- Ability to design marine propulsion systems, which requires calculations based on fluids flow, thermodynamics, strength of materials, hydraulics, heat transfer, vibrations, and wind laboratory test data.

- These knowledges are such as could be acquired through a bachelor's degree program in mechanical engineering, supplemented by several years experience in design of mechanical systems and some experience with a marine environment.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

Supervisor assigns projects in terms of scope, general objectives and time limitations. The employee independently plans and carries out the work, but the supervisor is available for consultation on novel design features. Completed work is reviewed generally for technical adequacy.

Factor 3. Guidelines-Level 3-3 -- 275 Points

Guidelines include detailed specifications of the ships, agency guide specifications and standard designs, technical handbooks and journals, manufacturers' catalogs, and past precedents. While nearly all problems are guided by past precedents or standard practices, these are not always completely applicable and the relationships of past practices to the problems at hand are sometimes not obvious. The employee independently selects and applies the guides, making some compromises and adaptations to meet the varying requirements of different classes of vessels.

Factor 4. Complexity-Level 4-4 -- 225 Points

Assignments deal with a variety of types of vessels, with differing requirements. In addition, each project involves a number of different tests and studies concerned with the various components of the propulsion systems. In some instances, the employee must depart from previous test techniques in order to obtain the necessary data. While projects are generally of a conventional nature, they do include several complex features which require resourcefulness and experienced judgment in modifying standard practices to meet the unique requirements of a particular vessel.

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose of the work is to prepare plans and specifications for marine propulsion systems for a variety of vessels. The work has an impact on the safety, economy, efficiency, types and sizes of the systems to be installed.

PAGE 44 6/77 TS-28

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with other agency engineers and naval architects, manufacturers' representatives, contractors, and shipyard personnel, such as marine engine mechanics.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts are for the purpose of exchanging factual technical data required for coordination, explaining and interpreting agency requirements, and discussing debatable technical issues.

The work frequently involves disagreements that require tact and persuasion in making compromises or settling conflicts with other agency engineers and with contractors.

Factor 8. Physical Demands-Level 8-2 -- 20 Points

Frequent surveys of shipboard conditions require a considerable amount of walking, climbing and bending.

Factor 9. Work Environment-Level 9-2 -- 20 Points

Work requires regular shipboard visits which expose the employee to moderate discomforts, such as excessive heat and high noise levels.

TOTAL POINTS -- 2570

PAGE 45 6/77 TS-28

MECHANICAL ENGINEER, GS-830-11, Bmk #: 5

Duties

Performs office and field mechanical engineering duties associated with the design, layout, and construction of large industrial and office buildings, ensuring that the buildings' mechanical systems are planned in accordance with standard practices and constructed in accordance with contract plans and specifications. Mechanical systems include plumbing, space heating, cooling, ventilating, and particulate matter removal; storage and distribution systems for fuels, fire fighting, compressed air, and wastes; machinery such as pumps, fans, internal combustion engines, air compressors, and winches. Projects include new construction and additions and renovations to existing structures.

- Prepares mechanical portions of government estimates, reviews contractors' proposals and assists in negotiations with contractors.
- Reviews design architect-engineers' working drawings and specifications which indicate building size and general arrangement and final drawings and specifications, all for conformance with accepted practice and agency requirements. Recommends necessary changes.
- Makes field surveys to investigate existing equipment layout and conditions. Writes reports recommending corrective action on deficient conditions.
- Analyzes mechanical needs, makes calculations and determines types of systems most suitable to meet requirements of building within the prescribed budget.
- Prepares original designs and preliminary and final layouts and specifications for the above named systems, machinery, and equipment.
- Sizes systems, machinery, and equipment, according to the facilities' needs, ensuring conformance with agency specifications.

- Coordinates assignments with other agency engineers and architects responsible for the adequacy of related features such as lighting, power and structures to ensure proper integration of the assignment.
 - Reviews and recommends approval of mechanical equipment, shop drawings, and technical data submitted by contractors, ensuring conformance with contract documents and making recommendations as to the suitability of new processes and methods.
- PAGE 46 6/77 TS-28
- Investigates, when directed, a variety of problems which the contractor experiences in construction, such as interference between mechanization and other specializations or other modifications in the original design which the contractor feels are necessary or desirable. Advises the contracting officer on such technical matters as they affect the contract and provides justification and cost estimates if changes are expected to modify the contract amount.
 - Participates in final on-site inspection.
 - Acts as project engineer over the planning and design phase of maintenance and improvement projects, applying management techniques, knowledge of mechanical engineering, the physical sciences, and standard Government contracting practices.

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250 Points

- Professional knowledge of mechanical engineering concepts, principles and practices applicable to the full range of engineering duties concerned with the design and layout of a variety of mechanical systems and equipment for large industrial and office buildings.
- Familiarity with related engineering fields, such as electrical and structural.
- Ability to design mechanical utilities such as would be acquired through a bachelor's degree program in mechanical engineering, supplemented by several years experience in design of mechanical utility systems.

Factor 2. Supervisory Controls-Level 2-3 -- 275 Points

Supervisor assigns work in terms of project objectives and priorities. The employee determines the nature of the questions and issues involved and independently plans and carries out the work assignment according to accepted engineering practices. Unusual or complex problems are referred to the supervisor, accompanied by recommendations or alternate solutions. Completed work is reviewed for adequacy, soundness of technical judgment and compatibility with work of other engineers. Detailed calculations, findings and recommendations on routine assignments are accepted as technically accurate, but may be checked or verified.

Factor 3. Guidelines-Level 3-3 -- 275 Points

Guidelines include agency instructions on mechanical engineering matters, manufacturers' literature, mechanical engineering texts, and precedents for similar situations. Such guides are not always wholly applicable to the problems requiring resolution so the employee must exercise judgment in their selection and application to specific problems, for example, modifies designs during construction to eliminate interferences with other specializations or solve other design deficiencies.

Factor 4. Complexity-Level 4-4 -- 225 Points

The assignments are diverse covering a number of essentially different mechanical systems and equipment. The employee must adapt and modify conventional practices and apply design criteria to the projects assigned. Problems encountered include interferences with other specializations and the need to choose between several approaches used in past projects. The work also requires recognition of the relationship of problems and practices of related engineering fields either to solve the engineering problem or refer it to the appropriate source.

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The incumbent's duties require the investigation of a wide range of conditions, recommendation of the most effective solution to the problems they generate, and responsibility for the rendering of suitable designs for a variety of systems and equipment. The work affects the efficiency, economy and safety of the systems and equipment involved.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with agency officials, contractors, architect-engineers, professionals in other agencies and agency personnel within and outside of the employee's own office.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts with agency engineers and managers are to convince them, because of engineering considerations, of the superior merits of solutions other than their own. Contacts with agency field technical personnel are to motivate them toward safe use of equipment and to ensure the continuing use of pollution control apparatus installed to comply with regulations. Participates in the negotiation of construction contract costs with private firms and reviews work of architect-engineer firms and construction contractors.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Occasional physical activity is required including walking, bending, or stooping during field surveys or the inspection of the installed equipment.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is performed primarily in an office setting, although there are occasional visits to project sites.

TOTAL POINTS -- 2365

PAGE 49 6/77 TS-28

MECHANICAL ENGINEER, GS-830-12, Bmk #: 1*Duties*

Serves as a mechanical engineering specialist with responsibility for developing the designs, plans, and specifications for plumbing, heating, ventilating, air conditioning and other systems of major size and complexity for use in government facilities, including multi-story office buildings, steam plants, hospitals and similar structures. Also prepares drawings and specifications for private architect-engineer contracts and reviews contractor's designs. Typically is assigned projects of considerable difficulty, i.e., containing combinations of unusual features, requiring significant departures from previous approaches to similar projects. In addition, serves as a technical advisor to lower grade engineers on complex design problems.

- Performs or directs the survey and investigations at the project site to determine condition of facilities and to secure necessary data prior to initiating design, evaluates the data obtained and incorporates the salient factors into design considerations and solutions.
- Coordinates with other engineers and architects in design development to ensure that all technical areas are covered, areas of overlapping responsibilities between technical disciplines receive proper design consideration and that the total project objectives and schedules are met.
- Evaluates design objectives, performs complex technical calculations, identifies most economical and efficient procedures for project design and performance considering all influences and prepares necessary drawings, specifications and supporting documents for advertised or negotiated procurement.
- Prepares detailed cost estimates for use in obtaining project funding and bid evaluation.
- Prepares correspondence, technical reports, estimates, fact sheets, status reports and schedules as required to complete project assignments.
- Consults with construction contractor personnel to resolve difficult and complex unforeseen problems and latent conditions developing during construction and based on

the condition, prepares sketches or change drawings and specifications solving the problem and incorporates these change documents into the contract performance documents.

PAGE 50 6/77 TS-28

- Reviews and evaluates shop drawings, samples and material certifications submitted by contractor for contract and performance requirements, recommending approval, rejection or receipt.
- Periodically reviews the work of architect-engineer firms to ensure design excellence and that space requirements are met.
- Furnishes technical advice to lower grade engineers on possible approaches to the solution on specific design problems.
- Assists in training new mechanical engineers in the organization.

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250

Points

- Professional knowledge of mechanical engineering concepts, principles, and practices applicable to the full range of engineering duties concerned with the design and layout of plumbing, heating, ventilating, air conditioning and other systems for use in multistory office buildings, steam plants, hospitals and similar structures.
- Ability to design large and complex mechanical systems such as could be acquired through a bachelor's degree program in mechanical engineering, supplemented by a considerable amount of design experience.
- Familiarity with related engineering fields, such as electrical and structural.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

The supervisor gives assignments in general terms and indicates priorities and overall objectives. The employee is considered to be a specialist in the field and is expected to exercise judgment in analyzing and developing solutions to the project objectives. Completed work is reviewed to ensure compatibility with these objectives.

Factor 3. Guidelines-Level 3-4 -- 450 Points

Guidelines include manuals, engineering regulations, established procedures, policy statements and the terms of contracts. The employee must use experienced judgment and initiative in applying and adapting mechanical engineering principles and practices where significant departures from established practices and precedents are required, resulting from such factors as unusual local conditions or the increased emphasis on energy conservation.

PAGE 51 6/77 TS-28

Factor 4. Complexity-Level 4-5 -- 325 Points

Assignments involve new design, design modifications, requirements definition and engineering evaluations. The assignments are diverse in nature and cover a number of essentially different mechanical systems and equipment found in large, multi-story office buildings, steam plants and hospitals. The employee must exercise creativity and experienced judgment in extending traditional techniques or developing new ones in order to solve complex engineering problems. In some cases the assignments deal with the inapplicability of established design criteria and technical precedents to projects objectives thus requiring sound design judgment to bring the project to solution, meeting major objectives without compromising design and engineering principles. The work also requires recognition of the relationship of problems and practices of related engineering fields either to solve the engineering problem or refer it to the appropriate source.

Factor 5. Scope and Effect-Level 5-4 -- 225 Points

As a specialist in the design of mechanical utility systems, performs the design work on major agency projects and furnishes technical advice to other mechanical engineers on specific design problems. Work has an impact on a wide range of agency construction projects.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with personnel of the client agency, including agency officials and space management personnel, contractors, and agency personnel within and outside the employee's own division.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts personnel of client agency to determine their space requirements and design needs. Confers with contractors to solicit advice in resolving design problems and also participates in contract negotiations. Has contracts with agency engineering and architectural personnel to give or receive information, to coordinate work efforts, to furnish technical advice, to review drawings, designs or specifications and correct as necessary. Contracts with construction contractors and architect-engineers firms often require persuasion and tact in the resolution of technical disagreements.

PAGE 52 6/77 TS-28

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Occasional physical activity is required including walking or bending in the inspection of the installed equipment or during construction stage visits.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is performed primarily in a office setting. There is occasional exposure to conditions in buildings and facilities that are under construction.

TOTAL POINTS -- 2890

MECHANICAL ENGINEER, GS-830-12, Bmk # 2*Duties*

Serves as project engineer for several major mechanical engineering projects associated with the design of floating plant, including seagoing self-propelled hopper dredges, pipeline dredges, floating power plants, tugboats, towboats, surveyboats, derrickboats, oil and water barges, etc. Projects include both repair and improvement jobs and design of new systems. Incumbent is responsible for in-house design and specification and review of designs prepared by contractors. As the technical specialist for dredging equipment performs or directs much of the design work in that specialty for equipment of the agency, nationwide.

- Upon receipt of project goals, conducts feasibility study to determine a design solution to a specific operating requirement or problem.
- Performs complex calculations and prepares designs and specifications or directs and advises other engineers and technicians in the design and specification of individual systems, components and details.
- Coordinates complex features with engineers of other disciplines and naval architects, particularly with the electrical and hull sections, as well as the using activity.
- Has extensive contacts with equipment manufacturers and suppliers to find sources and technical information on specialized equipment.
- Serves as a trouble-shooter by making visits to field activities to investigate a problem and develop possible solutions. This often involves the redesign of systems and writing of specifications for installation of new equipment.
- Formulates test programs and operating procedures for mechanical machinery and equipment on floating plant.
- Makes special studies of unconventional operating requirements.

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250 Points

- Professional knowledge of mechanical engineering principles and practices applicable to the full range of engineering duties concerned with design of mechanical systems used on floating plant.
- In addition to standard professional mechanical engineering knowledges, this specialty requires knowledge of ship design and ship operating conditions and of the specialized factors associated with a marine environment.

PAGE 54 6/77 TS-28

- Familiarity with related engineering disciplines, particularly electrical.
- Ability to perform complex mechanical design work for floating plant, such as could be acquired through a bachelor's degree program in mechanical engineering, supplemented by several years of design experience and some experience with a marine environment.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

Supervisor indicates general problems, overall objectives and furnishes guidance on critical issues and policy matters. Employee is responsible for independently planning and carrying out the work, coordinating with others, and resolving problems as they occur. Work is reviewed for adequacy of results and compliance with basic objectives.

Factor 3. Guidelines-Level 3-4 -- 450 Points

Guidelines include agency policies and regulations, standard technical literature, manufacturers' catalogs, precedents and practices in the specialty field. Because of the individualized requirements of different vessels and the broad responsibility in the dredging specialty, the employee must use ingenuity and originality in developing new or improved techniques and methods for obtaining effective results and overcoming unusual problems where guides and precedents are lacking.

Factor 4. Complexity-Level 4-5 -- 325 Points

Assignments involve the full range of mechanical equipment aboard floating plant. Tasks require innovative and skillful improvisation due to the specialized dredging equipment involved and the custom-made qualities of each ship based on varying operating requirements. Projects contain a combination of complex features requiring a high degree of technical judgment, originality and resourcefulness to (1) recognize possible new directions of approach and devise new or improved techniques and methods for obtaining effective results, (2) overcome difficult and unusual problems where precedents are not directly applicable, (3) apply the latest technological advances relating to the specialization, and (4) analyze and evaluate designs, proposals and ideas submitted by others.

PAGE 55 6/77 TS-28

Factor 5. Scope and Effect-Level 5-4 -- 225 Points

The purpose of the work is to provide technical expertise in the design of mechanical systems aboard floating plant, by performing complex design work and advising on and reviewing that performed by others. Work efforts affect a large group of agency floating plant, with a nationwide impact on dredging activities.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contracts are with officials, managers and other engineers within other offices of the agency, technical personnel of the using activity, equipment manufacturers and suppliers, and contractors.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts are to exchange information, coordinate on projects, obtain information about equipment and resolve problems of activities and contractors. Some contacts require the employee to influence or persuade other engineers to adopt technical points about which there are disagreements, such as in the selection of one approach from a number of alternatives.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Work is mostly sedentary, but there is some walking, climbing and bending required during inspections aboard vessels.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Most work is performed in an office setting, although there is some exposure to shipyard conditions during inspections.

TOTAL POINTS -- 2890

PAGE 56 6/77 TS-28

MECHANICAL ENGINEER, GS-830-12, Bmk #3*Duties*

Serves as a mechanical engineering specialist with responsibility for design of mechanical equipment and features of large civil works construction projects such as multipurpose dams and river navigation structures. The mechanical equipment and features include spillway and outlet gate hoists, lock operating machinery and utilities, pumps, sluice gates, and compressed air, water supply, sewage, heating, ventilating, air conditioning and fire protection systems. Typically, the magnitude of such projects, as well as the public concerns associated with them, require treatment of combinations of complex features, including technical and socio-economic considerations.

- Prepares preliminary design studies, design memoranda, final design calculations and plans, technical specification provisions and labor and materials estimates for above features.
- Coordinates the design of mechanical equipment with features designed by others to ensure the equipment conforms with related design plans.
- Reviews mechanical portions of engineering designs prepared by architect-engineer firms for the above and similar type systems and facilities. Checks for proper interpretation and application of criteria to ensure that design drawings and analyses of design are accurate and that conclusions and assumptions are sound. Notes deficiency and

discrepancies and prepares comments and recommendations for the correction of designs by architect-engineer firm.

-- Reviews mechanical portions of contractors' and manufacturers' shop drawings to evaluate the adequacy and practicability of the equipment or system design. Checks items of mechanical equipment proposed for use to determine their suitability and compliance with the intended function. Makes determinations regarding the compliance of contractors' proposals with the intent of contract plans and specifications. Drafts replies to contractors and manufacturers, regarding the mechanical portions of shop drawings, setting forth the basis for exceptions taken and revisions required in proposed mechanical equipment or features.

-- Makes field trips to construction sites to study and develop reports and design data pertinent to exact site conditions.

PAGE 57 6/77 TS-28

Factor 1. Knowledge Required by the Position-Level 1-7 -- 1250 Points

-- Professional knowledge of mechanical engineering concepts, principles and practices applicable to the full range of engineering duties concerned with the design of mechanical equipment and features of a large civil works construction program.

-- Familiarity with related engineering fields, such as electrical, civil and sanitary.

-- Knowledge of adequacy and practicability criteria, intent of plans and specifications and waiver requirements sufficient to monitor contractor's proposals.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

The immediate supervisor indicates the overall project objectives and consults with the employee on the development of schedules and completion of projects. Essentially, the employee is responsible for planning and carrying out the work, coordinating with others, and resolving most problems which occur. The supervisor is available for consultation on major problems. Completed work is reviewed for effectiveness in meeting requirements and to ensure conformance with agency policies and regulations.

Factor 3. Guidelines-Level 3-4 -- 450 Points

Guidelines include manuals, engineering regulations, established procedures, policy statements, and the terms of contracts. These guidelines are frequently inadequate in dealing with the more complex problems, requiring the employee to use experienced judgment and resourcefulness in selecting, adapting and applying engineering principles and practices to situations where precedents are not applicable due to factors such as unfavorable local conditions or the need to deviate from established practices in order to keep costs below a prescribed level.

Factor 4. Complexity-Level 4-5 -- 325 Points

Assignments involve new design, design modifications, requirements definition and engineering evaluations. The assignments are diverse in nature and cover a number of essentially different mechanical systems and equipment found in large civil works construction projects such as multi-purpose dams and river navigation structures. The employee must exercise creativity and experienced judgment in extending traditional techniques or developing new ones in order to solve complex engineering problems. In some cases, the assignments deal with the inapplicability of established design criteria and technical precedents to project objectives, thus requiring sound design judgment to bring the project to solution, meeting major objectives without compromising design and engineering principles. The work also requires recognition of the relationships of problems and practices of related engineering fields either to solve the engineering problem or refer it to the appropriate source.

PAGE 58 6/77 TS-28

Factor 5. Scope and Effect-Level 5-3 -- 150 Points

The purpose of the work is to design mechanical equipment and features of civil works construction projects and to review the adequacy of contractor's design proposals. Work has an impact on the safety, economy, efficiency, types and sizes of systems to be installed.

Factor 6. Personal Contracts-Level 6-3 -- 60 Points

Contacts are with architect-engineer firms, contractors, manufacturers, field project personnel, and with personnel of other sections such as electrical engineers, structural engineers, civil engineers, and architects within the branch and design engineers in any discipline necessary to design components.

Factor 7. Purpose of Contracts-Level 7-3 -- 120 Points

Contacts are to exchange information, coordinate on projects, obtain information about equipment and resolve problems of activities and contractors. Some contacts require the employee to influence or persuade other engineers to adopt technical points about which there are disagreements, such as in the selection of one approach from a number of alternatives.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Occasional physical activity is required including walking, bending, or stooping during field surveys or inspection of site and equipment.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is usually performed in a office setting; there is occasional exposure to conditions at civil works projects that are under construction.

TOTAL POINTS -- 2815

PAGE 59 6/77 TS-28

MECHANICAL ENGINEER, GS-830-13, Bmk # 1

Duties

Serves as staff specialist in the Mechanical Section of a regional engineering office in planning, directing and coordinating the mechanical engineering activities for civil works and agency construction in the region. The employee's expertise covers a wide range of heating, ventilating and air conditioning systems for building of many sizes; various types of hospital mechanical equipment; fire protection systems, safety service and communication systems for missile assembly control and satellite launching facilities; rocket propellant fuel systems (both solid and liquid); pumping equipment for flood control projects; and mechanical equipment for steam and hydroelectric power plants.

- Reviews or directs the review of the mechanical features of plans, specifications, and analyses of design as submitted by the field offices in the seven state region for accuracy and technical competency and approves such plans, specifications and analyses where the authority is vested in the chief engineer of the region.
- Where deficiencies are noted, directs necessary changes and furnishes assistance required.
- Advises field office personnel on methods and procedures to be used in special studies on highly complex mechanical systems as for missile research facilities. Approves such systems or facilities based upon the results of these studies.
- Serves as a consultant and a technical expert for the region, field offices and architect-engineers concerning the mechanical features, as described above.
- Interprets policies, regulations, and engineering criteria as established by headquarters engineers and provides such information to the field offices.
- Makes field inspections of proposed projects to determine directive and design requirements, inspects such projects under construction to determine the adequacy of the design of mechanical features and to assure conformance to plans and specifications.
- Prepares and processes technical reports and papers on important and highly complex mechanical engineering matters which influence the current and future programs of the region.

PAGE 60 6/77 TS-28

Factor 1. Knowledge Required by the Position-Level 1-8 -- 1550 Points

- Mastery of advanced concepts, principles, and practices of mechanical engineering that enables incumbent to serve as an expert in the full range of mechanical systems for civil works and agency construction projects.
- The ability to apply new developments or experimental theories to problems not readily treatable by accepted methods.
- Knowledge of related engineering fields including civil, structural and electrical.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

Supervisor establishes, in consultation with the incumbent, the overall objectives of the work assigned. The employee carries out assignments independently, resolving most conflicts which arise, coordinating the work with others as required. Interprets policy and regulations independently considering the established objectives of the work assignment. Methods to be used and approaches taken in problem solutions are typically determined by the incumbent. The incumbent is accountable for the engineering decisions made which are not normally reviewed in detail for technical adequacy.

Factor 3. Guidelines-Level 3-4 -- 450 Points

Guidelines include such publications as agency regulations, technical literature, manufacturer's catalogs, and policy statements issued by the headquarters engineers. Technical guides have limited applicability to many problems encountered. As a technical specialist, the employee must exercise judgment and creativity in deviating from such traditional methods as may be available; and adapts and develops new methods as required. Serves as regional authority to interpret and provide advice on policies, regulations and engineering criteria issued by headquarters to engineers in the region's field offices.

Factor 4. Complexity-Level 4-5 -- 325 Points

Assignments involve work in a broad range of activities and highly specialized mechanical engineering functions. As a consultant and technical expert for the region, the employee makes engineering decisions concerning a broad range of mechanical systems and equipment. In addition, the employee is confronted with novel and obscure problems which require the extension of existing methods and the development of new approaches. For example, projects concerned with highly complex mechanical systems for missile research facilities involve combinations of complex features, technical and socio-economic in nature.

PAGE 61 6/77 TS-28

Factor 5. Scope and Effect-Level 5-4 -- 225 Points

The purpose of the work is to provide program direction and expert technical advice in the specialty field. Projects for which the employee makes decisions are often valued in the multi-million dollar range. Work performed by the incumbent has a significant impact upon the agency's engineering program in a seven state area.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Personal contacts are with agency engineering personnel and officials, professionals and managers of other agencies and organizations. Also, the employee has frequent contact with individuals and groups in the private sector which would include executives of manufacturing concerns and architect-engineers.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts are to resolve difficulties, and control the work performed by mechanical engineers within the field offices. Some persuasion may be necessary in obtaining adoption of technical points and methods that are in conflict with desires and opinions of other engineers. In addition, contacts are made with higher level agency and installation officials to coordinate activities so that the desired effect may be achieved. Some contact is also made with those in the private sector including manufacturing concerns, architect-engineers and construction firms, to discuss contract requirements or developments in the specialty field.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Sedentary work.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is performed in an office environment, with some travel to attend meetings or to review field operations.

TOTAL POINTS -- 3190

PAGE 62 6/77 TS-28

MECHANICAL ENGINEER, GS-830-13, Bmk # 2*Duties*

Serves as the regional technical authority in utilities production and distribution, with responsibility for providing expert advice on the interpretation and implementation of technical utilities policy directives and programs. Also, serves as senior engineer team leader during visits to activities for the purpose of making surveys and/or providing consultative services concerning mechanical engineering aspects of all utility systems, with specific emphasis in the areas of diesel, gas turbine and steam electric power generation, steam and high temperature water generation, compressed air production and distribution, air conditioning, refrigeration and heating systems.

- Receives guidelines from headquarters outlining general requirements of the programs. Develops and distributes detailed procedural guides or instructions for activities, use in implementing the programs. In addition, serves as program liaison contact with activities to ensure consistency of interpretation and implementation of the programs.
- Serves as team leader for mechanical engineers engaged in the administration and technical accomplishment of engineering utilities programs such as the following:
 1. Review of all air conditioning applications.
 2. On-site verification of sampling techniques and analysis results of agency's coal sampling program.
 3. Review of all mechanical utilities activity plans, specifications and cost estimates for technical adequacy.
 4. Recommends required levels of training to activities and establishes operations and maintenance standards for new or unusual applications of mechanical equipment.
 5. Analyses of equipment to determine efficiency and to recommend replacement, repair or improvement.
 6. Development of specialized engineering analyses and solutions of technical operating and maintenance problems.
 7. Evaluation of mechanical systems from an energy conservation standpoint.

PAGE 63 6/77 TS-28

- Provides consultative engineering service for activities in the full range of mechanical utilities systems.

Factor 1. Knowledge Required by the Position-Level 1-8 -- 1550 Points

- Mastery of advanced concepts, principles, and practices of mechanical engineering to serve as a technical authority in utilities production and distribution.
- Ability to apply latest developments in solving problems not readily treatable by accepted methods.
- Knowledge of related engineering fields such as civil, structural and electrical.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

Supervisor provides overall requirements of assignments and assistance on controversial problems or matters of far-reaching impact. The employee and supervisor work together in developing priorities and timetables for work accomplishment. As the region's technical expert in the specialty, the employee independently carries out studies and renders advice to activities. Completed work is reviewed only to ensure effectiveness in administering assigned programs and in providing consultative services to activities.

Factor 3. Guidelines-Level 3-4 -- 450 Points

Guidelines used include all of the standard technical material available to mechanical engineers - agency policies and regulations, standard textbooks, manufacturers' catalogs and

handbooks, standard designs and guide specifications developed by the agency's central engineering staff and established practices. As the region's technical authority in utilities, the employee is confronted with many problems for which these guidelines are inadequate, requiring the employee to exercise judgment and resourcefulness in modifying or extending traditional methods when precedents are not applicable. Is also responsible for development of instructions and explanatory material to supplement guidelines issued at the headquarters level.

Factor 4. Complexity-Level 4-5 -- 325 Points

Assignments involve the full range of mechanical engineering activities associated with utilities production and distribution. Surveys and consultations with field activities require the ability to solve novel problems, to modify and extend standard techniques and to develop new approaches. The work requires the employee to provide field activities with authoritative advice and direction on a wide range of engineering programs.

PAGE 64 6/77 TS-28

Factor 5. Scope and Effect-Level 5-4 -- 225 Points

The purpose of the work is to provide expertise in the design, improvement, maintenance and operation of mechanical utilities systems. Work efforts have a significant impact on the region's utilities program.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Personal contacts are with other engineers at headquarters and field activities, private architect-engineers, building operators, industry representatives, agency officials and managers, and fellow members of professional engineering associations.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts are for the purpose of exchanging information, coordinating work efforts, discussing equipment requirements, and resolving questions or problems of field personnel. Some contacts require the employee to influence or convince other engineers to adopt approaches about which they may be skeptical.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Work is mostly sedentary, although there is some walking, bending and climbing associated with on-site inspections.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Most work is performed in an office setting, but there is some exposure to conditions in facilities under inspection, construction, or repair.

TOTAL POINTS -- 3190

PAGE 65 6/77 TS-28

MECHANICAL ENGINEER, GS-830-13, Bmk # 3*Duties*

Is responsible for the development, revision, and up-to-date maintenance of agency mechanical engineering guide specifications and criteria, as well as portions of agency technical handbooks for guidance of headquarters and field staff and contract architect-engineers. These publications cover new construction, repair and improvement, and extension and remodeling of Federal office buildings and related facilities. Also is responsible for: (1) preparation, revision and maintenance of graphical data for use in mechanical equipment and systems design; (2) furnishing advice and counsel to the agency regional offices, contract architect-engineers and representatives of other agencies on matters pertaining to the use and interpretation of the assigned criteria; (3) conducting studies, investigations and tests, through practical application in buildings, of new mechanical equipment, devices and materials from standpoint of economy of design, operation and maintenance and the betterment of existing and proposed new facilities.

- Through coordination with other branches or divisions, contacts with individuals and technical organizations, the reading of technical reports, study of Federal Procurement Regulations and discussions with industry representatives, the employee determines what revisions are necessary in the assigned criteria, and follows through to assure that necessary changes are made.
- Reviews and furnishes information to regional offices on technical criteria problems presented to the Central Office for review and assistance.
- Makes visits to regional offices or field inspections of projects where complex problems have arisen and renders advice in their solution.
- Prepares comprehensive technical reports, bulletins and issuances for regional guidance, reflecting the results of research studies and tests of new mechanical equipment.
- Maintains close liaison with Government and private professional engineers, architects, research organizations, industry, technical organizations and building operators in order to keep abreast of the latest developments within the specialization, and to provide current information for use in the revision and updating of mechanical engineering criteria.
- Serves on various technical committees.
- Provides testimony as an expert witness on appeals cases.

PAGE 66 6/77 TS-28

-- Prepares technical information for publication in technical journals or for discussion at technical conferences.

Factor 1. Knowledge Required by the Position-Level 1-8 -- 1550 Points

- Mastery of concepts, principles and practices of mechanical engineering that enables the employee to serve as a technical specialist in the development of agency guide specifications and design criteria for mechanical systems in a variety of Federal buildings.
- The ability to evaluate and incorporate the latest developments in the field into the technical guidelines for which the employee is responsible.
- Knowledge of related engineering fields, such as structural, electrical, etc.

Factor 2. Supervisory Controls-Level 2-4 -- 450 Points

Supervisor assigns work in terms of overall objectives, priority emphasis, budget and project coverage. Within the assigned area of responsibility, the employee is expected to independently render advice, take actions and carry out assignments. At own discretion, the employee refers controversial issues or those having a far-reaching effect on the overall programs to the supervisor, along with the proposed course of action. Completed work is reviewed for effectiveness in meeting requirements and compatibility with the work of other engineering specialists in the organization.

Factor 3. Guidelines-Level 3-5 -- 650 Points

As a recognized technical authority in mechanical systems, the employee is responsible for the development of agency guide specifications, design criteria and technical handbooks. Working only under general policy statements, the employee must exercise considerable judgment in determining what revisions and additions are necessary in the assigned technical material. Guidelines include agency regulations and policy statements, Federal Procurement Regulations, technical reports, and manufacturers' publications. While these publications are helpful, the employee must use a high degree of originality and creativeness in adapting and extending these guides in solving a variety of complex technical criteria problems.

PAGE 67 6/77 TS-28

Factor 4. Complexity-Level 4-5 -- 325 Points

Assignments involve the entire range of mechanical systems found in Federal buildings. Primary responsibility is the development of technical guidelines for use of Central Office, regional offices and contract architect-engineers involved in new construction and repair and improvement work. As a technical expert in the field, the employee is resourceful and innovative in solving novel and obscure criteria problems, which typically involve combinations of complex features.

Factor 5. Scope and Effect-Level 5-5 -- 325 Points

The purpose of the work is to provide expertise on mechanical systems to agency headquarters and field personnel and private architect-engineers, in the form of guide specifications, design criteria, and technical handbooks. The employee also renders advice and assistance in their use and interpretation. Work performed impacts on the work of other agency mechanical engineers, nationwide, and in some cases affects the work of engineers at other agencies or in private industry.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Personal contacts are with engineering personnel at headquarters and in the regions, building operators, headquarters officials and professionals of other agencies, industry representatives, and fellow members of national engineering committees.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

The chief purpose of the contacts is to provide technical expertise on matters within the specialty area including many controversial issues. The employee is required to influence or persuade other engineers to adopt technical points about which there is disagreement.

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Sedentary work.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is performed primarily in an office setting, although there is some travel to regional offices or project sites.

TOTAL POINTS -- 3490

PAGE 68 6/77 TS-28

MECHANICAL ENGINEER, GS-830-14, Bmk # 1*Duties*

Serves as a nationally recognized consultant and expert in construction of mechanical facilities with responsibility for observing advising and reporting on mechanical engineering activities for military construction projects including installations being built for a number of agencies, worldwide. Projects include facilities of unusual size and complexity, such as

missile launching facilities and also require dealing with unusual environmental conditions, including those associated with arctic or tropic climates.

- Visits field offices and construction projects to observe and report on technical features of construction operations pertaining to all specializations within the mechanical engineering field.
 - While at the construction site, evaluates quality of workmanship; compliance with directives, authorized standards, approved plans and specifications and other requirements; rate of construction progress; organization and management of construction operations; and need for materials expediting or other assistance.
 - Technically checks the facility for its adaptability to the site, terrain, climatic conditions and adherence to sound engineering principles.
 - Recommends immediate cessation of construction if, according to the employee's judgment, such action is imperative.
 - While in field, acts as a consulting engineer by rendering staff assistance to the resident engineer, contractor and regional and district office engineers.
 - Upon completion of field visits, conducts an exit interview with the engineers responsible for the construction activities of the field office to indicate findings and make recommendations for any immediate corrections.
 - Upon return to headquarters, writes formal report on findings and recommendations.
 - Examines preliminary and final design features of mechanical systems prepared by architect-engineers or agency field engineers to determine that they will produce a satisfactory end product.
 - On the basis of field evaluations and further studies, recommends needed changes in agency guide specifications, standard plans and specifications, technical manuals and bulletins, etc.
- PAGE 69 6/77 TS-28
- As a technical expert in construction, acts as a troubleshooter by visiting field installations with special problems and devising solutions.
 - Makes inspections of completed construction, usually about a year after the facility has been turned over to the using activity, to evaluate and report on maintenance and operation of the facilities.

Factor 1. Knowledge Required by the Position-Level 1-9 -- 1850 Points

- Mastery of advanced principles and practices of mechanical engineering in order to investigate and provide consultative services on the entire range of mechanical engineering construction activities.
- Ability to serve as a nationally recognized consultant and expert on construction operations.
- Ability to apply new developments and experienced judgment to solve a variety of highly complex technical problems.
- Working knowledge of related engineering fields, such as electrical and structural in order to evaluate construction projects from a broad perspective.

-- These knowledges and abilities are such as would be acquired through extended training and experience in design and construction of mechanical systems.

Factor 2. Supervisory Controls-Level 2-5 -- 650 Points

Supervisor provides general administrative direction, but instructions on individual assignments are usually limited to selection of which construction projects or field offices are to be evaluated or given technical assistance. The employee has independent responsibility for planning and carrying out evaluations and rendering expert advice to other engineering specialists and program directors. Decisions, recommendations and findings are considered technically authoritative and are reviewed only with respect to their effect on the overall construction program.

Factor 3. Guidelines-Level 3-4 -- 450 Points

Guidelines include agency regulations and policy, agency guide specifications, technical manuals and bulletins, manufacturers' catalogs and standard practices. These guidelines are rarely adequate for solving the complex and unusual construction problems with which the employee is faced, thus requiring the employee to exercise considerable judgment and ingenuity in extending existing methods and developing new ones.

PAGE 70 6/77 TS-28

Factor 4. Complexity-Level 4-5 -- 325 Points

Construction evaluations and consultative services cover the entire range of mechanical engineering specializations involved in the construction of all types of government facilities. Reviews work containing a variety of complex features being performed by engineering specialists at numerous locations under diverse conditions. The employee must be versatile and innovative in extending methods or developing new approaches to solve a variety of novel and complex construction problems.

Factor 5. Scope and Effect-Level 5-5 -- 325 Points

The purpose of the work is to investigate, evaluate, and provide expert advice on mechanical engineering aspects of the agency's construction program. The complex nature of much of the work requires sound judgment, as well as innovation in resolving critical problems, extending techniques or developing new approaches. Through the field evaluations and reports on the results, as well as the consultative services, the employee's work efforts have a significant impact on the agency's construction program, worldwide. Included in this impact is a role in the development of agency guidelines (guide specifications, design criteria, etc.) through recommendations of needed changes or additions, based on findings of field evaluations.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Contacts are with resident engineers at the construction sites; engineering specialist, the chief of engineering and/or the chief of construction at the field offices; contractors; manufacturers; officials and managers of the using agency; and other engineering experts in the various disciplines at headquarters.

Factor 7. Purpose of Contacts-Level 7-3 -- 120 Points

Contacts are for the purpose of exchanging information, coordinating on projects or the overall construction program, discussing equipment requirements, and most importantly, rendering consultative services and discussing deficiencies, recommendations and overall findings resulting from the field evaluations. Exit interviews with the high level engineering personnel in the field offices who are responsible for construction activities often involve serious conflicts over technical evaluations and proposed approaches.

PAGE 71 6/77 TS-28

Factor 8. Physical Demands-Level 8-2 -- 20 Points

The work requires considerable walking, bending and climbing during the frequent construction inspections.

Factor 9. Work Environment-Level 9-2 -- 20 Points

Construction evaluations and technical consultations require the employee to be on-site at construction projects where there is exposure to the various risks and discomforts associated with a construction environment.

TOTAL POINTS -- 3820

PAGE 72 6/77 TS-28

MECHANICAL ENGINEER, GS-830-14, Bmk # 2*Duties*

Is responsible for the development and implementation of new systems engineering approaches to the design of mechanical utility systems using performance specifications. Provides leadership and expert advice to other segments to the agency, both central office and regional offices, to other agencies, and to contract architect-engineers on total mechanical engineering systems, particularly those for buildings of major size and complexity.

- Conceives, plans and conducts work in unexplored areas involving the implementation of building systems where there are little or no previous experience factors for guidance. Has technical responsibility for continuation or abandonment of the work subject to approval of higher authority.
 - Develops test procedures for components of installed building systems and evaluates test results therefrom to appraise the desirability for further application of the systems in the agency construction program.
 - Provides technical direction to regional offices and to contract architects and engineers where complex problems have arisen in applying new systems building techniques.
 - Conducts liaison with high officials and technical personnel of other agencies on engineering problems relating to systems building affecting projects being built for them by the agency.
 - Maintains a continuous overview of the building systems program to determine the adequacy and effectiveness of engineering policies, procedures and plans. Seeks to search out and overcome any actual or potential problems in applying building systems techniques to specific projects and recommends proposed solutions.
 - Prepares or reviews feasibility studies, special reports and investigations on problems that have to do with building subsystems, their related user needs and testing requirements.
 - Coordinates and reviews broad programs containing large amounts of engineering work being conducted at regional offices throughout the nation.
 - Has responsibility for developing procedures and instructions to be used throughout field offices with regard to special programs that require a broad knowledge of agency policies, laws and regulations. Conducts seminars and workshops to disseminate program information to the public.
- PAGE 73 6/77 TS-28
- Serves as a member of national engineering councils which formulate fundamental concepts and policies in the technical area of mechanical systems and equipment design resulting from research programs in leading universities and industry.
 - Develops standards and guides for use of field personnel for inspections of mechanical building systems.
 - Participates in selection of construction management firms for projects, by providing guidance to regional office personnel who evaluate firms' proposals and, periodically, by participating in interviews of firms.
 - Conducts periodic visits to field to provide on-site advice and reviews.

Factor 1. Knowledge Required by the Position-Level 1-8 -- 1550 Points

- Knowledge of principles and practices of mechanical engineering that enables employee to provide expert advice to headquarters and field personnel in all areas of design and construction of mechanical systems.
- Ability to apply new developments to problems not readily treatable by accepted methods.
- Ability to generate new mechanical engineering program for the agency.
- Knowledge of related engineering fields, such as structural, electrical.

-- Ability to communicate effectively, in the capacity of spokesman for the agency in many areas of the employee's expertise.

Factor 2. Supervisor Controls-Level 2-5 -- 650 Points

Works under general administrative supervision with independent responsibility for actions, decisions, and commitments in the broad programs for which the employee is responsible. Completed assignments are considered technically authoritative and are normally accepted without significant change. Assistance is available from the supervisor in matters which may affect the policies of the organization.

PAGE 74 6/77 TS-28

Factor 3. Guidelines-Level 3-5 -- 650 Points

Guidelines are broadly stated agency regulations and policy statements, engineering manuals and manufacturer's publications. Because much of the work is in unexplored areas or deals with unyielding problems, the guidelines often have very limited applicability to the work performed. Exercises judgment and ingenuity in deviating from such traditional methods as may be available, and adapts and develops new methods as required. In addition, the employee is recognized as the agency's technical authority in the development of a number of agency guidelines.

Factor 4. Complexity-Level 4-5 -- 325 Points

Assignments involve work in a broad range of activities and highly specialized mechanical engineering functions. Each project typically involves many, varied complex features. The employee must take actions and make decisions in solving highly complex technical, administrative and socio-economic problems involved in implementing new systems building techniques, such as fast-tracking (simultaneous design and construction, which can cut project time in half) or the use of solar energy in government buildings. Thus the work involves many areas of uncertainty requiring development of new techniques and criteria.

Factor 5. Scope and Effect-Level 5-5 -- 325 Points

The primary purposes of the work are to provide expert advice and guidance to agency engineering personnel concerning unusual or critical problems, and to provide expertise and direction in the planning and development of new engineering programs. Work performed has major impact on agency construction programs, nationwide.

Factor 6. Personal Contacts-Level 6-3 -- 60 Points

Personal contacts are with engineering personnel at headquarters and in the regions, manufacturer's representatives, contractors and headquarters officials and professionals of other agencies. Represents agency on inter-agency task forces and national engineering councils.

Factor 7. Purpose of Contacts-Level 7-4 -- 220 Points

The purpose of the contacts is to provide technical expertise on matters within the program area. Assignments also involve active participation in high level conferences, negotiations, and meetings which have significant consequences in obtaining acceptance of new approaches to design or are otherwise considered of major importance.

PAGE 75 6/77 TS-28

Factor 8. Physical Demands-Level 8-1 -- 5 Points

Sedentary work.

Factor 9. Work Environment-Level 9-1 -- 5 Points

Work is performed in an office environment, with some travel to attend meetings or to review field operations.

TOTAL POINTS -- 3790